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U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF ORNITHOLOGY AND MAMMALOGY

BULLETIN No. 4

# THE PRAIRIE GROUND SQUIRRELS OR SPERMOPHILES OF THE MISSISSIPPI VALLEY

PREPARED UNDER THE DIRECTION OF

DR. C. HART MERRIAM, CHIEF OF DIVISION

BY

VERNON BAILEY

CHIEF FIELD AGENT

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PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE

WASHINGTON

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1893

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Trautmann, Bailey & Blampey, N.Y.

STRIPED SPERMOPHILE. SPERMOPHILUS TRIDECEMLINEATUS Mitchell.

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# LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ORNITHOLOGY AND MAMMALOGY,
*Washington, D. C., August 17, 1893.*

SIR: I have the honor to transmit herewith a report on the Ground Squirrels or Spermophiles of the Mississippi Valley, for publication as Bulletin No. 4 of this Division.

This report has been prepared by Mr. Vernon Bailey, chief field agent of the Division. Since it is intended as an economic bulletin it is devoted chiefly to the food habits and distribution of the several species, technical matter being omitted.

The accompanying illustrations were drawn by Mr. Ernest E. Thompson.

Respectfully,

C. HART MERRIAM,
*Chief of Division.*

Hon. J. STERLING MORTON,
*Secretary of Agriculture.*

# CONTENTS.


| | Page. |
|---|---|
| Letter of transmittal | 3 |
| List of illustrations | 7 |
| Introduction | 9 |
| Plan of the investigations | 11 |
| Correspondence | 11 |
| Field work | 13 |
| Laboratory work | 13 |
| Natural enemies of spermophiles | 15 |
| Bounties | 18 |
| Objections to the bounty system | 22 |
| Methods of destroying prairie dogs and spermophiles | 24 |
| Firearms | 25 |
| Fumigation | 25 |
| Traps | 25 |
| Poisoning | 25 |
| Experiments with bisulphide of carbon | 27 |
| Key to the species | 30 |
| Striped Prairie Spermophile (*Spermophilus tridecemlineatus*) | 31 |
| Mexican Spermophile (*Spermophilus mexicanus*) | 46 |
| Franklin's Spermophile (*Spermophilus franklini*) | 48 |
| Kennicott's Spermophile (*Spermophilus spilosoma obsoletus*) | 58 |
| Richardson's Spermophile (*Spermophilus richardsoni*) | 59 |

# ILLUSTRATIONS.

---

PLATES.


Page.

Plate I. Striped Spermophile (*Spermophilus tridecemlineatus*) .....Frontispiece.
II. Franklin's Spermophile (*Spermophilus franklini*)..... 48
III. Richardson's Spermophile (*Spermophilus richardsoni*)..... 58


MAPS.


Map 1. Distribution of the Striped Spermophile (*Spermophilus tridecemlineatus*).
2. Distribution of Franklin's Spermophile (*Spermophilus franklini*).
3. Distribution of Kennicott's Spermophile (*Spermophilus spilosoma obsoletus*) and the Mexican Spermophile (*Spermophilus mexicanus*).
4. Distribution of Richardson's Spermophile (*Spermophilus richardsoni*) and the Wyoming Spermophile (*Spermophilus richardsoni elegans*).

# THE PRAIRIE GROUND SQUIRRELS OR SPERMOPHILES OF THE MISSISSIPPI VALLEY.

## INTRODUCTION.

The destructive animals that form the subject of the present bulletin belong to the genus *Spermophilus*, and are commonly known as spermophiles. The name is derived from the Greek words σπέρμα, seed, and φιλεῖν, to love, in allusion to the fact that seeds form a large proportion of the food of the various species. In the Old World the spermophiles are known as sousliks, while in America they are popularly called gophers or ground squirrels. The term 'gopher,' however, belongs properly to a very different group of animals, to which it should be restricted, namely the pocket gophers which have external cheek pouches, and resemble the moles in living underground and throwing up little mounds along the courses of their subterranean tunnels. 'Ground Squirrel' is a less objectionable name, because these animals really are ground squirrels; the term is however commonly applied to the chipmunks belonging to the related genus *Tamias;* hence the name spermophile is here used in preference to either of the others.

The object of the present bulletin is to describe the haunts and habits of the five species inhabiting the Mississippi Valley region, and to summarize the remedies that have been used with greatest success in holding their numbers in check. *Spermophilus* is a large genus, and is found throughout the greater portion of the north temperate region of both hemispheres from eastern Europe across northern Asia, and over the western two-thirds of North America. The total number of species and subspecies of spermophiles inhabiting the United States is about thirty-five, and most of them are restricted to the arid and subarid region west of the Rocky Mountains. Throughout their range, wherever the land is under cultivation, they are among the most destructive of mammals, feeding on grain, fruit, and garden vegetables to such an extent that the annual losses from their depredations must be counted in hundreds of thousands of dollars. Several States have paid large sums in bounties for their destruction, without materially reducing their numbers.

The region here considered comprises the Mississippi Valley in a very broad sense, including the fertile prairies of the valley proper, and

also the Great Plains as far west as the foothills of the Rocky Mountains. In a north and south direction it embraces the vast area stretching from the Mexican boundary and the Gulf of Mexico north to the plains of the Saskatchewan River. It comprises the largest and by far the most important continuous stretch of agricultural land on the continent, and the greater part of it is now under high cultivation. Five very distinct species of spermophiles inhabit this region, four of which are restricted to it, namely: Richardson's Spermophile (*Spermophilus richardsoni*), Franklin's Spermophile (*Spermophilus franklini*), the Striped Spermophile (*Spermophilus tridecemlineatus*), and Kennicott's Spermophile (*Spermophilus spilosoma obsoletus*); the fifth, the Mexican Spermophile (*Spermophilus mexicanus*), ranges southward over the table-land of Mexico as far as the Valley of Mexico. Only two species (*S. franklini* and *S. tridecemlineatus*) range east of the Mississippi River, and these find their extreme eastern limits respectively in western Indiana and eastern Michigan.

On account of the immense damage done to crops these animals have been the subject of investigation at some of the agricultural colleges and experiment stations in the West, and several bulletins have been issued containing notes on their food habits or giving directions for their destruction.

In 1878 Prof. E.W. Hilgard, of the University of California, published a bulletin on the destruction of ground squirrels by the use of bisulphide of carbon.* This method has proved by far the most successful of any thus far put in practice, and has been largely adopted with gratifying success. (See pp. 29–30.)

Mr. E. J. Wickson in his work on California Fruits devotes a paragraph to methods of destroying ground squirrels in orchards.† He recommends three means of extermination: (1) Poisoned wheat; (2) bisulphide of carbon, and (3) 'smokers.' The latter term includes the various devices for burning sulphur or damp straw and forcing the fumes into the burrows, thereby suffocating the inmates.

In August, 1889, Prof. C. P. Gillette published the results of an examination of the stomachs of twenty-two specimens of the Striped Spermophile (*Spermophilus tridecemlineatus*) in a paper entitled 'Food Habits of the Striped Prairie Squirrel.'‡ He showed that this species is not an unmixed evil, for besides large quantities of grain, it eats numbers of grasshoppers, wireworms, and other noxious insects. He concludes that a large proportion of its food is made up of insects, which seem to consist almost exclusively of injurious species, chiefly cutworms, webworms, and grasshoppers, and adds: "The squirrels would be a most valuable adjunct to any cornfield after planting if some method could be devised to prevent them from taking the corn."

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* Bulletin of the University of California, No. 32, April, 1878.

† E. J. Wickson: The California Fruits and How to Grow Them. San Francisco, 1889, p. 554.

‡ Bulletin No. 6, Iowa Agricultural Experiment Station, August, 1889, pp. 240–244.

Continuing this same line of investigation, Mr. J. M. Aldrich, of the South Dakota Agricultural College and Experiment Station, published a paper on the Food Habits of the Striped Gopher, in March, 1892.* Mr. Aldrich, after referring to Prof. Gillette's previous examinations, also gives the results of an examination of fifteen stomachs made by himself, and says: "As far as our observations go they did not give the gopher as favorable showing as Prof. Gillette's did." (See pp. 40–42.)

One of the bulletins of the Oregon Experiment Station contains an important paper by Prof. F. L. Washburn on 'Gophers and Moles.'† It is devoted mainly to methods of destroying the pocket gopher (*Thomomys*) and mole (*Scapanus*), and gives several illustrations of traps said to be specially adapted for the capture of these animals. A few suggestions for destroying the 'Digger Squirrel'‡ are added, and bisulphide of carbon and strychnine recommended for this purpose.

Recently Prof. F. J. Niswander, entomologist of the Wyoming Experiment Station, has published a bulletin on 'Ground Squirrels.'§ After giving evidence from several correspondents as to the injuries caused by spermophiles in the vicinity of the station at Laramie, Wyo., he recommends the use of bisulphide of carbon for destroying the animals. Unfortunately the author has mistaken the southern form of Richardson's Spermophile (*Spermophilus richardsoni elegans*), found in this locality, for Franklin's (*S. franklini*), which latter is a widely different animal and one that does not reach Wyoming at all. This bulletin contains two full-length illustrations, one of the California Ground Squirrel (*Spermophilus beecheyi*), the other of the southern Rocky Mountain Spermophile (*Spermophilus grammurus*), neither of which species occurs in Wyoming.

## PLAN OF THE INVESTIGATIONS.

The work of bringing together the facts upon which the present bulletin is based may be arranged under three heads, namely, correspondence, field work, and laboratory work.

*Correspondence.*—In 1886 a circular was widely distributed in which information was asked for respecting the habits, ranges, and distribution of pocket gophers and spermophiles (Circular No. 3, Division of Ornithology and Mammalogy).

In response hundreds of letters were received, and while many of them contained matter of little value or statements that were evidently

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* South Dakota Agricultural College and Experiment Station, Bulletin No. 30, March, 1892, pp. 8–11.

† Oregon Agricultural Experiment Station, Bulletin No. 25, April, 1893, pp. 14–23, pl. III; 10 figs. in text.

‡ The species which occurs in Oregon is not *Spermophilus beecheyi*, as here given, but the closely related form *douglasii*.

§ Wyoming Experiment Station Bulletin, No. 12, April, 1893, pp. 25–35. Figs. 1–3.

incorrect, the greater number were simple statements of fact that added much new and original information to the previous knowledge of the habits and distribution of North American mammals. A marked interest in the subject was awakened throughout the country, and many naturalists and others in position to observe the habits of mammals contributed notes of especial interest.

In July, 1888, and again in January, 1889, copies of the following circular were distributed throughout the Mississippi Valley, asking for specific information respecting the Striped Spermophile (*Spermophilus tridecemlineatus*), Franklin's Spermophile (*Spermophilus franklini*), and the pocket gopher (*Geomys bursarius*) with a view to procuring data from which to map accurately the range of the several species and at the same time to gain as much information as possible concerning their food and all habits relating directly or indirectly to agriculture.

[CIRCULAR ON GOPHERS, NO. 9.]

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ECONOMIC ORNITHOLOGY AND MAMMALOGY,
*Washington, D. C.*, ——, *188—*.

Mr. —— ——,
—— ——:

DEAR SIR: The Department of Agriculture wishes to secure enough information concerning the range of the three species of Gophers which inhabit the Mississippi Valley to enable it to map with precision the exact area occupied by each. Any information relating to the subject, though not covered by the following questions, will be thankfully received.

* * * * * * *

I. Is the Striped Gopher or Ground Squirrel (*Spermophilus tridecemlineatus*) present in your neighborhood?

If so, is it destructive to farm crops?

Has it any beneficial traits?

II. Is the Gray Gopher or Ground Squirrel (*Spermophilus franklini*) present in your neighborhood?

If so, is it destructive to farm crops?

Has it any beneficial traits?

* * * * * * *

[Washington, D. C., July 30, 1888.]

The replies to this circular made it possible to map the range of these animals with greater accuracy and detail than otherwise could have been accomplished. Each locality from which specimens were examined was marked on a large map of the United States devoted to the species. These maps formed the basis for the accompanying distribution maps. Between the positive localities a multitude of reports of occurrence cover the ground, save in certain definite areas where for some reason the species does not occur. In determining the extreme limits of the range of each species, the localities from which it has been reported are of material assistance as indicating areas from which specimens should be obtained in order to settle beyond question the identity of the species. All doubtful records have been discarded.

Many of the replies to Circular 9, and to other special letters of inquiry, contained detailed accounts of injury to crops, interesting notes on the habits of the spermophiles, and various means employed for their destruction. A few extracts from these letters are given under each species and present the case as seen by those most deeply interested. Some of the reports may be prejudiced, but in many the good as well as the evil traits of the animals are recognized.

*Field work.*—Competent men employed by the Division as special field agents have been sent to parts of the country from which complaints had been received concerning the ravages of spermophiles. In some cases the reports of damage to crops were found to be exaggerated or attributed to the wrong species, and such errors were corrected by means of these field investigations. Specimens of the animals were collected for identification and comparison, their abundance was carefully estimated, their geographic range, details of distribution, breeding habits, food habits at different seasons of the year, and the various methods employed for their destruction were carefully studied, and a large number of stomachs was collected and preserved in alcohol for subsequent examination in the laboratory.

Nor were the investigations limited to spermophiles and pocket gophers, for some attention was given to the habits of their natural enemies, particularly the birds and mammals that prey upon them. In examining the stomachs of hawks and owls remains of spermophiles were frequently found, and in some instances the birds were seen in the act of catching or eating them. Badgers were found to spend considerable time in digging ground squirrels and pocket gophers out of their holes, and to be of no small importance in holding in check the numbers that otherwise would add their increase to present hordes. Other animals also were found to feed upon them, as mentioned in detail later.

*Laboratory work.*—Though the contents of many stomachs were examined in the field such examinations were made mainly for the purpose of learning the sort of food selected by the spermophiles so that their habits might be more fully understood. The stomachs of most of the specimens were preserved in alcohol, and each was labeled with a tag of parchment paper bearing a number in carbon ink. A corresponding number was entered on a schedule and followed by the name and sex of the animal, place where taken, date, hour at which killed, and such notes as might help in understanding any peculiarity of food found in the stomach. Such notes were usually a brief statement of the animal's surroundings when killed; as, 'near wheat field,' 'in meadow,' 'on open prairie,' or 'on edge of cornfield.' These preserved stomachs, together with the accompanying schedules, were forwarded to the Department for critical examination. Each stomach was cut open, the contents spread out on a plate, and enough water added to wash out the fine sediment. Among the coarser materials were found hairs, feathers, the outer coats of grains, shells of seeds,

the legs, wings, heads, and jaws of grasshoppers, beetles, and various other insects, the skins of caterpillars, and a great variety of things, as shown in the tables prepared from the examinations.

Unlike the contents of many birds' gizzards, everything had been chewed, not swallowed whole; very few complete insects were found in condition to be identified although it was often possible to recognize the genus but rarely the species. Grains and seeds could be identified more frequently. Softer materials, as foliage and flowers, could be easily distinguished as such, but the species could seldom be told. As far as possible the different materials from each stomach were separated and the relative proportions carefully estimated. The difficulty in perfectly separating the different kinds of food prevented any attempt at weighing or measuring to obtain precise proportions. Hence the percentages given are only approximate.

In examining the contents of cheek pouches much more definite results were obtained. The seeds and grains carried in them were usually in perfect condition and easily identified by comparison with seeds in the laboratory collection.

In the preparation of this bulletin the mass of original notes contributed by observers has been supplemented by frequent references to the literature of the subject, and numerous extracts have been made from reliable sources. The results of the investigations of several experiment stations have been freely used. Part of the chapter on methods of destruction, and some of the notes on *Spermophilus tridecemlineatus*, *S. franklini*, and *S. richardsoni*, together with the plates illustrating these species, have already appeared in a paper by the author in the Annual Report of the U. S. Department of Agriculture for 1892, pp. 186–189.

It would be impracticable, even were it desirable, to mention the large number of correspondents who have contributed data. Some have sent in specimens, others valuable notes on the range or habits of the several species, while the answers received to letters of inquiry on the subjects of distribution and bounties alone number several hundred. Much information on the distribution of these spermophiles is still needed from localities near the limits of their ranges. But without the assistance so freely given it would have been almost impossible to determine precisely the areas inhabited by the species, and acknowledgments are due to all who have aided the work.

## NATURAL ENEMIES OF SPERMOPHILES.

The most important natural enemies of spermophiles are the diurnal birds of prey. Day after day the marsh hawk (*Circus hudsonius*) may be seen gliding over fields and prairies, occasionally making a sudden turn and diving to the ground to pick up a mouse or spermophile. According to Dr. A. K. Fisher, "Its food consists largely of small rodents, such as meadow mice, half-grown squirrels, rabbits, and spermophiles or ground squirrels. In fact, so extensively does it feed on the last-named animals that the writer rarely has examined a stomach from the West which did not contain their remains."* The heavier hawks, as the red-tail and Swainson's hawk, inhabiting the prairie country also subsist largely upon them.

Even the ferruginous roughleg (*Archibuteo ferrugineus*), one of the largest of our hawks, is not above making a meal of one when an opportunity offers. I once surprised one of these hawks in a hot pursuit of a Striped Spermophile, which, however, succeeded by active dodging in reaching a hole in time to escape. "This bird is known as the 'California squirrel hawk' in some localities, but it is not to be inferred that they often capture the agile arboreal *Sciuri*. The name is gained from their feeding extensively, in California, upon the 'ground squirrels' (*Spermophilus beecheyi*), which abound in many parts of that State. The hawks are almost always, too, observed in the vicinity of the settlements of the *Spermophili*, standing on the ground where there are no trees, or flying low over the surface, in either case on the alert to seize any unlucky animal that may venture too far from home. They are also said to perch in wait at the entrance of the burrows, ready to clutch the first animal that shows his nose above ground."†

Ordinarily owls and spermophiles do not meet, as each sleeps during the hours in which the other is active. The diurnal snowy owl and hawk owl may find other spermophiles far to the north, but in winter, when they come south over the United States, these animals are in their winter dens. The little burrowing owl (*Speotyto c. hypogæa*), though active both day and night, feeds principally upon grasshoppers and beetles; but once I shot one as it carried a nearly full-grown Striped Spermophile in its claws. It is probable that it destroys many of the smaller species of spermophiles or their young.

Capt. Chas. E. Bendire gives the following account of an experiment showing that the burrowing owl will kill and eat adult spermophiles: "In this vicinity [Walla Walla, Wash.] these owls seem to live to a great extent on that pest of the farmer, Townsend's Ground Squirrel (*Spermophilus richardsoni townsendi* Allen), which would be much more destructive if not kept down by these owls. In order to satisfy myself

*Bulletin No. 3, The Hawks and Owls of the United States, 1893, p. 27.

†Coues, Birds of the Northwest, 1874, p. 366.

that they were actually able to kill adult squirrels, I trapped several and placed them alive (they had been caught in a wire trap and were not at all injured) in a room with a pair of these owls. As soon as noticed by the latter, one of them would fasten his talons into the squirrel's back and, with a few well-directed strokes of its beak, break the vertebræ of the neck and eat the head of the squirrel, often before the latter was quite dead; yet the remainder of the body was usually left and devoured later. I was surprised to see how easily they killed these squirrels, which made scarcely any resistance." (Ornithologist and Oölogist, Vol. VI, 1881, pp. 41–42.)

No less than 16 of the 73 species and subspecies of hawks and owls found in the United States and British America are known to prey on the various members of the genus *Spermophilus*. The following species have been reported to feed on these animals, and more careful observations will undoubtedly increase the list:

| HAWKS. | OWLS. |
|---|---|
| *Circus hudsonius.* | *Strix pratincola.* |
| *Accipiter cooperi.* | *Bubo v. subarcticus.* |
| *Parabuteo u. harrisi.* | *Nyctea nyctea.* |
| *Buteo b. krideri.* | *Surnia ulula caparoch.* |
| *Buteo b. calurus.* | *Speotyto c. hypogæa.* |
| *Buteo swainsoni.* | *Glaucidium g. californicum.* |
| *Archibuteo ferrugineus.* | |
| *Aquila chrysaëtos.* | |
| *Haliæetus leucocephalus.* | |
| *Falco mexicanus.* | |

In our investigations of the food of hawks and owls the remains of spermophiles were actually found in the stomachs of 22 specimens representing 7 species of these birds. The total number of stomachs of these species examined was 981. This proportion (about $2\frac{1}{4}$ per cent) does not represent the true percentage of spermophiles in the bird's food inasmuch as a very large number of the stomachs were obtained from birds killed in the eastern United States where spermophiles do not occur. Thus, in a total of 562 stomachs of the redtail (*Buteo borealis*) and its subspecies, 477 were taken in States east of the range of *Spermophilus;* and of 127 stomachs of the great horned owl (*Bubo virginianus*) only 53 were taken within the range of this genus, and of these 11 were empty. If, on the other hand, all empty stomachs and all those taken outside the range of *Spermophilus* are discarded (a total of 799), the percentage containing spermophiles is increased from $2\frac{1}{4}$ to 12; while 23 per cent of the marsh hawks examined, 25 per cent of the prairie falcons, and 40 per cent of Harris' hawks were found to have fed on these animals, as shown in detail in the following table:

*Table showing stomachs of Hawks and Owls which contained Spermophiles.**

| Species. | Locality. | Date. | Spermophiles. | Total number of stomachs examined.† |
|---|---|---|---|---|
| Marsh hawk | Travare, S. Dak | July 5, 1887 | Spermophilus 13-lineatus | |
| Do | Pembina, N. Dak | July 30, 1887 | ditto | |
| Do | ditto | ditto | ditto | |
| Do | ditto | ditto | ditto | |
| Do | Devils Lake, N. Dak | Aug. 11, 1887 | ditto | |
| Do | Cheyenne, Wyo | Aug. 21, 1888 | ditto | |
| Do | Birch Creek, Idaho | Aug. 4, 1890 | Spermophilus mollis | 30 |
| Cooper's hawk | Three Rivers, Cal | July 28, 1891 | Spermophilus beecheyi | 22 |
| Harris' hawk | Phœnix, Ariz | May 13, 1889 | Spermophilus tereticaudus. | |
| Do | ditto | ditto | Spermophilus | 5 |
| Red-tailed hawk | Devils Lake, N. Dak | Aug. 11, 1887 | Spermophilus franklini and S. 13-lineatus. | |
| Do | Vermillion, S. Dak | Apr. 9, 1890 | Spermophilus 13-lineatus | |
| Do | San Francisco Mt., Ariz. | Aug. 3, 1889 | Spermophilus lateralis | |
| Do | ditto | Aug. 26, 1889 | ditto | |
| Do | ditto | Sept. 16, 1889 | ditto | |
| Do | ditto | June 12, 1887 | ditto | |
| Do | Marfa, Texas | Jan. 19, 1890 | Spermophilus grammurus. | 60 |
| Swainson's hawk | Birch Creek, Idaha | Aug. 4, 1890 | Spermophilus mollis | 15 |
| Prairie falcon | Cheyenne, Wyo | Aug. 3, 1888 | Spermophilus 13-lineatus | |
| Do | Laramie Mts., Wyo | Aug. 4, 1888 | Spermophilus richardsoni elegans. | 8 |
| Horned owl | Camp Verde, Ariz | Oct. 28, 1885 | Spermophilus harrisi | |
| Do | ditto | Aug. 28, 1886 | Spermophilus grammurus. | 42 |

*Compiled from tables in Bulletin No. 3, The Hawks and Owls of the United States, 1893.
†Only those stomachs which contained food and which were taken within the region inhabited by spermophiles are included.

Among mammals, the spermophiles' greatest enemy is undoubtedly the badger which makes a regular business of finding and digging out the holes in which they live, and devouring the occupants. I have found their remains in a badger's stomach after the spermophiles had hibernated, so that none could be caught in traps. In speaking of the habits of this animal, Dr. Coues says:

"The badger, too slow of foot to capture the nimble rodents which form its principal food, perpetually seeks them in their own retreats; and it is the work of a few minutes for this vigorous miner to so far enlarge their burrows that it can enter and reach the deepest recesses. In places where the badgers and spermophiles most abound, the continual excavation of the soil by these animals fairly undermines and honeycombs the ground." (Fur-Bearing Animals, 1877, p. 281.) Though the badger indulges in quite a varied diet spermophiles are his main dependence, and where they are abundant badgers are usually abundant also. As the country becomes settled, badgers are killed whenever opportunity offers, either for sport or because they have been known to trouble the poultry yard. As a result the spermophiles increase more rapidly unless other means be employed for their destruction.

Foxes, coyotes, and wild cats do not lose an opportunity to dine upon any small mammal that comes in their way, though as the greater part of their hunting is carried on at night fewer spermophiles than nocturnal animals fall to their prey. Doubtless a few of the smaller species are captured by skunks, though a greater part of the food of the

skunk consists of smaller game, insects, and fruit. The long-tailed weasel (*Putorius longicauda*) is one of their most deadly enemies. It readily enters the burrows and kills the occupants without the slightest inconvenience. On the prairies of the Dakotas, Nebraska, and Wyoming they may frequently be seen running quickly from one hole to another, and as is usual with weasels, they probably kill far more than they can eat, merely for the pleasure of killing. These weasels always seem to be rather scarce, else no spermophiles would remain alive.

There is no doubt that the larger snakes destroy great numbers, especially of the young, though definite information on the subject is scarce. I have frequently found large bull snakes (*Pituophis*) crawling in or out of their holes, and have found pocket gophers and other animals of the size of small spermophiles in the snakes.

Thus it may be seen that without the aid of man there are abundant provisions for regulating the abundance of these animals and preventing their too rapid increase. The great danger is that in some of his blind efforts to rearrange matters in a more satisfactory manner man will destroy his friends instead of his enemies.

## BOUNTIES.

The damage done by spermophiles is so great that the expedient of offering bounties for their destruction has been tried in several States where these pests are most abundant. Iowa, North and South Dakota, Minnesota, Montana, and more recently Washington, have all expended large amounts in this way.

In 1888 and 1889 an attempt was made to ascertain the amounts actually paid for the destruction of spermophiles and pocket gophers in the Dakotas, Iowa, and Minnesota, but owing to the difficulty in obtaining accurate returns, the investigation was abandoned. With the exception of Minnesota there were no State laws, the bounties being paid by the counties, and this necessitated obtaining returns from the auditor of each county. A more serious difficulty was the fact that these returns included bounties on several species of mammals, and sometimes birds, and gave merely the total amount expended, making it almost impossible in most cases to ascertain the proportion paid for the destruction of each species. In the following tables given under each State returns are included only from counties which it is reasonably certain paid some part of the bounty on spermophiles. In some cases the county records were found to be very incomplete, and in others no replies were received to the letters of inquiry sent out, so that only a part of the counties which have actually paid bounties are included. For these reasons the tables are necessarily very incomplete and are only included for the purpose of giving a general idea of the large amounts expended for the destruction of ground squirrels.

*Dakota.*—Bounties in the Territory of Dakota were paid by the counties, there being no Territorial bounty. The following resolutions passed

by the board of county commissioners of Rolette County may be taken as an example of the law under which the bounties were paid: "That a bounty of 3 cents each be paid for the killing of each gopher within the following described territory in the county of Rolette. * * * The tails of all gophers caught to be preserved and taken before one of the officers hereinafter mentioned, and an affidavit made and subscribed before such officers, setting forth that the gophers were killed within the boundaries of said territory, and since the passage of this resolution, and the several officers hereinafter designated * * * are instructed to carefully examine the persons making such affidavit as to the truthfulness of their statement set forth therein, and such officers to preserve the tails of the gophers so caught and return them together with the affidavits taken by them."

Under the above resolution county warrants were issued to the amount of $1,940.85 for 64,695 gopher tails produced and verified by affidavits.

The following table shows that ten counties now included in North Dakota expended $37,248.16 for the destruction of spermophiles, while three counties now in the State of South Dakota paid $2,247.86, of which $74.63 was spent for pocket gophers.

*Table showing bounties paid on Spermophiles by Counties of North Dakota.*

| County. | Rate. | Date. | Total amount paid on spermophiles and other animals. | Total bounty paid by county. | Remarks. |
|---|---|---|---|---|---|
| | *Cents.* | | | | |
| Barnes | 3 | 1887<br>1888 | *$9,000.00<br>6,000.00 | $15,000.00 | |
| Benson | 2<br>3 | 1886<br>1887 | 300.00<br>1,200.00 | 1,500.00 | July 7 to Aug. 6.<br>Apr. 11 to June 11. |
| Bottineau | 3<br>3 | 1886<br>1887 | 400.00<br>1,100.00 | 1,500.00 | May 1 to July 1. |
| Cavalier | †20 | 1887<br>1888<br>1889 | 1,800.00<br>700.00<br>3,500.00 | 6,000.00 | |
| Griggs | 3 | 1887 | 5,200.60 | 5,200.60 | Bounty withdrawn. |
| La Moure | ..... | ..... | ..... | ..... | "County has expended thousands of dollars to destroy the gray gopher."—George R. Fralick, La Moure, N. Dak., Aug., 1888. |
| Nelson | 4<br>3 | 1886<br>1887 | 177.32<br>4,363.25 | 4,540.57 | July to September.<br>April to July. |
| Ramsey | 3 | 1887 | 774.05 | 774.05 | May and June. No bounty in 1888. |
| Rolette | 4 | 1887 | 1,940.85 | 1,940.85 | June 8 to Sept. 6; gray gophers predominated about 4 to 1. |
| Towner | 2½<br>3 | 1888<br>1889 | 396.21<br>395.88 | 792.09 | |
| Total | ..... | ..... | ..... | 37,248.16 | |

* Approximate. † Per dozen.

*Table showing bounties paid on Spermophiles by Counties of South Dakota.*

| County. | Rate. | Date. | Total amount paid on spermophiles and other animals. | Total bounty paid by county. | Remarks. |
|---|---|---|---|---|---|
| | *Cents.* | | | | |
| Edmunds | 3 | 1888 | $1,800.00 | $1,800.00 | 3 per cent pocket gophers. |
| Hyde | 2 | 1887 | 412.00 | 412.00 | 5 per cent pocket gophers. |
| Potter | 1 | 1886 | 35.86 | 35.86 | |
| Total | ..... | ..... | ..... | 2,247.86 | Includes $74.63 for pocket gophers. |

*Iowa.*—Sections 1487 and 1488 of the Code of Iowa (1873) provided for the payment of bounties on wolves and other large animals but not on gophers or spermophiles. Elsewhere the power was conferred on the board of supervisors at any regular meeting "To determine what bounties, in addition to those already provided by law, if any, shall be offered and paid by their county on the scalps of such wild animals taken and killed within their county as they may deem it expedient to exterminate. But no such bounty shall exceed five dollars." (Code of Iowa, 1873, Title N, Chap. 2, Sec. 303.)

Under this law eight counties expended $14,031.96 for the destruction of Gray and Striped Spermophiles previous to the year 1890, as shown in the following table:

*Table showing bounties paid on Spermophiles by Counties of Iowa.*

| County. | Rate. | Date. | Total amount paid on spermophiles and other animals. | Total bounty paid by county. | Remarks. |
|---|---|---|---|---|---|
| Boone | 5 cents, striped | 1888 | $2,000.00 | $2,000.00 | |
| Cerro Gordo | 3 cents | 1864–1865 | 954.45 | 954.45 | June 9, 1864, to Oct. 18, 1865. |
| Franklin | 2 cents, striped | 1885 | †750.00 | 4,456.00 | 75 per cent for striped and gray in 1889. |
| | | 1887 | 965.00 | | |
| | 3 cents, gray | 1888 | 1,195.00 | | |
| | | 1889 | 1,546.00 | | |
| Hancock | | 1888 | 1,150.00 | 1,150.00 | |
| Humboldt | 3 cents, striped | 1888 | 2,198.01 | 4,598.01 | June 1 to July 1, 1888. |
| | 5 cents, gray | 1889 | 2,400.00 | | |
| Ida | 10 cents, gray | 1878–1882 | *700.00 | 700.00 | Bounty in force 1878–1882. |
| O'Brien | 5 cents, striped | 1874? | | | |
| | 8 cents, gray | | | | |
| Plymouth | 2½ cents, striped | 1875–1876 | †560.00 | 560.00 | |
| | 5 cents, gray | | | | |
| Total | | | | 14,418.46 | Includes $386.50 for other species. |

* Amount paid in one month. † Approximate.

*Kansas.*—No attempt was made to ascertain the amount expended in Kansas, but it is probable that bounties were offered in several counties. Mr. J. S. Betzer, of Copeland, Kans., reported that the county of Thomas paid a bounty of 3 cents per scalp during the spring of 1890. The total amount expended was more than $5,000, which, however, included a small sum paid for bounties on wolves.

*Minnesota.*—In the spring of 1887 the State of Minnesota passed the following bounty laws:

AN ACT TO PROVIDE BOUNTIES FOR THE DESTRUCTION OF GOPHERS AND BLACKBIRDS.

*Be it enacted by the Legislature of the State of Minnesota—*

SECTION 1. That gophers and blackbirds are declared public nuisances and any person who shall kill or destroy said gophers in this State shall be entitled to receive five (5) cents each for every pocket gopher so killed by him, and three (3) cents each for all other kinds of gophers so killed.

SEC. 2. That it shall be the duty of the chairman of the board of supervisors of each town, on the production to him of the dead bodies of all such gophers * * *

killed as aforesaid in the town of which said chairman is supervisor, and of which he shall have satisfactory evidence were killed by the person so producing such bodies, to issue his certificate under his official signature to the county auditor of the county * * * giving the number of said gophers so killed and thereupon the county auditor shall draw and issue a warrant on the county treasurer for the amount such person is entitled to receive under the provisions of the preceding section of this act. * * *

SEC. 3. This act shall take effect and be in force from and after its passage. (General Laws of Minnesota for 1887, Chap. 144.)

This act was approved March 8, 1887, and under it bounties were paid by sixteen counties to the amount of $46,197.53. In many of the counties the money was paid largely or exclusively for the destruction of pocket gophers and blackbirds. Those which paid bounties in part for the destruction of spermophiles are shown in the following table. In this State the bounties for spermophiles were paid mainly on the Striped Gopher (*Spermophilus tridecemlineatus*).

*Table showing bounties paid on Spermophiles by State of Minnesota.*

| County. | Rate. | Date. | Total amount paid on spermophiles and other animals. | Total bounty paid by county. | Remarks. |
|---|---|---|---|---|---|
| | *Cents.* | | | | |
| Becker | ..... | 1887<br>1888 | $1,630.27<br>2,982.12 | $4,612.39 | Probably not more than $100 paid for blackbirds. |
| Blue Earth | ..... | 1887 | 2,190.28 | 2,190.28 | 10 per cent expended for pocket gophers ($219.02). |
| Hubbard | *3 | 1888 | 294.00 | 294.00 | |
| Le Sueur | *3 | 1888<br>1889 | 79.89<br>185.00 | 264.89 | |
| McLeod | *3 | 1887 | 222.11 | 222,11 | For six months. |
| Martin | *3 | 1887 | 13,000.00 | 13,000.00 | About $225 paid for pocket gophers. |
| Meeker | *3 | 1887 | 981.84 | 981.84 | May 1 to Oct. 1. |
| Nicollet | *3 | 1887 | 2,025.00 | 2,025.00 | May 3 to Dec. 31. |
| Nobles | ..... | 1887 | 1,997.24 | 1,997.24 | May 18 to Aug. 28, 90 per cent for Striped Spermophiles. |
| Norman | ..... | 1887 | 1,071.71 | 1,071.71 | June 1 to Nov. 15. This includes a few dozen blackbirds. |
| Pope | 3<br>½ | 1887<br>1889 | † 2,000.00<br>† 2,100.00 | 4,100.00 | |
| Renville | 3 | 1887 | 4,200.00 | 4,200.00 | $200 paid for pocket gophers. |
| Scott | 3 | 1887<br>1888<br>1889 | 289.93<br>774.36<br>1,078.34 | 2,142.63 | May 16 to Dec. 31.<br>Jan. 1 to Dec. 31.<br>Jan. 1 to Oct. 26, 35 per cent for pocket gophers ($377.41). |
| Sibley | ..... | 1887<br>1888 | 2,450.00 | 2,450.00 | May 18, 1887, to Jan. 15, 1888; $250 for pocket gophers. |
| Wabasha | ..... | 1887–89 | 5,279.28 | 5,279.28 | 90 per cent for pocket gophers ($4,751.35). |
| Winona | 3 | 1887 | 1,366.16 | 1,366.16 | May 1 to Nov. 1; 75 per cent for pocket gophers ($1,024.62). |
| Total | ..... | ..... | ..... | 46,197.53 | |
| Less bounties on pocket gophers, etc. | ..... | ..... | ..... | 7,147.40 | |
| Total for spermophiles. | ..... | ..... | ..... | 39,050.13 | |

* For Striped Spermophiles. † Approximate.

*Montana.*—In 1887 Montana offered a bounty of 5 cents each on ground squirrels and prairie dogs. The law took effect March 5 and remained in operation about six months. On September 12, 1887, bounties had

been paid on 698,971 ground squirrels, making the total expenditure $34,948.55. During the same period more than $15,000 had been paid for the destruction of prairie dogs, and the money in the treasury having been exhausted the law was repealed without having diminished the number of spermophiles or prairie dogs to any perceptible extent.

*Washington.*—During the year 1892 the county of Lincoln paid $31,071.06 for the destruction of Townsend's Spermophiles (*Spermophilus townsendi*), according to the report of the auditor dated October 8, 1892. This bounty was paid from February to June, inclusive, at the rate of 5 cents per scalp in February, 4 cents in March, 3 cents in April, 2 cents in May, and 1 cent in June. It is estimated that 1,035,702 scalps were presented. In addition to this a large number of animals undoubtedly escaped only to die in their holes or were killed during the hot weather and their scalps not presented, so that the figures do not show the total number actually destroyed.

The total amounts paid by the seven States for the destruction of spermophiles, as shown by the very incomplete returns received, are as follows:

| | | |
|---|---|---|
| Iowa | 1864–1865, 1878–1882, 1885–1889 | $14,031.96 |
| Kansas | 1890 | 5,000.00 |
| Minnesota | 1887–1889 | 39,050.13 |
| Montana | 1887 | 34,948.55 |
| North Dakota | 1886–1889 | 37,248.16 |
| South Dakota | 1886–1888 | 2,173.23 |
| Washington | 1892 | 31,071.06 |
| Total | | 163,523.09 |

## OBJECTIONS TO THE BOUNTY SYSTEM.

The experience of nearly all the States which have paid bounties for the destruction of injurious animals has been that the system is not only very expensive, but unsatisfactory. In the case of Montana the money in the treasury was exhausted before the act had been in operation six months, and yet the numbers of ground squirrels were not perceptibly diminished. The experience of Benton County, Iowa, with pocket gophers also shows the disastrous effects of offering high bounties: In 1866 a bounty of 10 cents per scalp was paid. The following year the bounty was increased to 20 cents, amounting to $10,000. This caused the county to borrow $3,000, and still left gopher warrants unpaid to the amount of $3,000 additional. The bounty was then reduced to 12 cents for six months, then to 10 cents, and was finally abolished in January 1, 1869, the entire amount paid out in three years being about $18,000, but the gopher, although greatly reduced in numbers, was not exterminated.

The result was hardly more successful in the Dakotas and Minnesota, and in several cases the bounties were withdrawn within a few months

of the passage of the law. The report received from Nelson County, N. Dak., showed that $4,363.25 had been paid for the destruction of spermophiles between April and July, 1887. The report states: "The attempt to put down the gopher raid was a failure, as it was impossible to follow the 1887 bounties without bankrupting the county. The county has twenty-eight full townships and 227,000 acres under cultivation, which gives too much gopher lands." The county of Griggs, N. Dak., offered a bounty of 3 cents per tail for gophers during the spring of 1887, and reported $5,200.60 paid out before the bounty was withdrawn. Mr. George R. Fralick, of La Moure, N. Dak., wrote in 1888: "This county [La Moure] has expended thousands of dollars to destroy the Gray Gopher, and there are thousands of them yet to destroy our crops."

In Minnesota, under the act of 1887 Meeker County paid bounties from May 1 to October 1, when the payments were discontinued as it was said that there were as many gophers as before, although $14,056.34 had been expended for the destruction of pocket and Striped Gophers. In Nobles County the act of 1887 was accepted May 18, but the bounty was ordered discontinued after August 28. During this period the amount paid was $1,997.24, about 90 per cent of which was for Striped Gophers and the balance about equally divided between pocket and Gray Gophers and blackbirds.

Several counties reported fraudulent payments of bounties. In Ramsay County, N. Dak., tails were received as evidence. This was unsatisfactory, as "it was proved that some of our clever young Americans divided the caudal appendage in two pieces and claimed bounty for each piece, or caught breeders, cut their tails off, and let them go, so as to give them a chance to raise more bounty-producing gophers." The report from Madison County, Iowa, which offered bounties on the several species of gophers indiscriminately, showed that bits of gopher hide with holes cut in them to imitate scalps were presented for payment. "This involved the county in lawsuits, and the bounty on scalps was repealed."

Dissatisfied with the effects of the bounty laws, the commissioners of several counties in North Dakota offered poison free of charge to the farmers for the destruction of gophers. In the year 1888 Benson County distributed $100 worth of strychnine and reported the results satisfactory so far as the extermination of the pests was concerned, although some stock was poisoned. The number of gophers killed during this year was said to be larger than during the previous year under the bounty act. In the spring of the same year Nelson County furnished $200 worth of the strychnine to the farmers, but reported the experiment unsuccessful. Wheat soaked in a solution of poison was used during May and June. These months were wet, and it was supposed that the moist ground destroyed in some measure the effects of the poison. During the years 1887 to 1889 Wells County furnished $500 worth of strychnine and reported the result successful.

In the State of Washington a large amount of money has also been expended in poison for the destruction of Townsend's Spermophile (*Spermophilus townsendi*). Dr. J. W. Lockhardt, of Saint John, Whitman County, under date of June 8, 1892 writes: "I think it no exaggeration to say that the farmers of this county [Whitman] spent $3,000 this year for the poison for this pest and yet many acres of grain are already destroyed."

Evidently a bounty can be but a temporary expedient for the extermination of these or other animals. Even if a sufficient amount of money were appropriated to completely exterminate a species in a given locality, its numbers would soon be reduced to a certain limit where it would cease to be profitable to hunt the animals, and the bounty would consequently become inoperative.

"Bounties offered for the destruction of harmful species seldom accomplish the desired end, and if success does finally result it is only after vastly larger expenditures than were at first thought necessary. After a harmful species—the wolf, for example—has become rather scarce in any section of country the offer of a bounty may lead to its complete extermination; and to attain such a result, it is certainly good economy to make the bounty large. Obviously, it is better to pay a large sum at once for the last few pairs of wolves in a district than to offer a bounty so small that it is little inducement to a hunter to spend his time in their pursuit. In this latter case the wolves easily hold their own for many years, or even increase slowly, while the aggregate bounties paid will far exceed all expectation. In order to be effective a bounty should be large enough to assure the destruction of the great majority of the individuals during the first year, and this is especially true of species which are very numerous and prolific. And yet the amount of money required for the payment of bounties in such cases would be so enormous as to make the plan impracticable."*

A full discussion of this phase of the subject may be found in a section devoted to the question of bounties on the English sparrow.†

## METHODS OF DESTROYING PRAIRIE DOGS AND SPERMOPHILES.

Experience has shown that in many ways spermophiles render valuable service to the farmer, but when they are numerous about grain fields they must be disposed of or in some way prevented from attacking the crop, else great loss will be sustained. Still, a wholesale destruction is not to be recommended; unless they do serious damage, spare them for the good they do, and at least let them remain on the prairies and in the meadows and pastures.

The injury which they do to crops, however, is an evil of such magnitude over more than two-thirds of the total area of the United States,

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*Bulletin No. 1, The English Sparrow in America, 1889, pp. 153–154.

†Loc. cit., 153–163.

that there is a general demand for some economical means of destroying them. The various means used with greater or less success may be divided into four general classes: (1) fire arms, (2) fumigation, (3) traps, (4) poisoning by strychnine and bisulphide of carbon.

*Fire arms.*—Under certain circumstances, where not too numerous or too shy, limited areas may be freed from spermophiles by shooting the animals. In California, where the large ground squirrels (*Spermophilus beecheyi*), fairly swarm in some of the valleys, hunters make good wages by shooting them for the market. The meat of the young animals is tender and delicate in flavor and brings almost as high a price as that of rabbits. Ordinarily, however, where the spermophiles are sufficiently abundant to make it worth while to hunt them for profit, they soon become exceedingly wary and difficult to shoot, and it is necessary to resort to some other less expensive and more efficient method to destroy them entirely.

*Fumigation.*—Various devices have been patented for destroying burrowing rodents, especially ground squirrels, by suffocation. This is accomplished by forcing the smoke of burning straw or sulphur into the burrows by means of 'smokers' or fumigating machines, and the fumes soon overcome the inmates. When the holes have more than one entrance it is necessary to take the precaution to close all but one to prevent the escape of the smoke. When the work is done thoroughly this is often a very efficient means of destroying the pests. The disadvantages, however, arising from the fact that the fumigating machines are more or less expensive, as well as somewhat unwieldy to carry about, render this method of less value than the simpler ones of trapping or poisoning.

*Traps.*—Trapping is slower than poisoning, but has the advantage in being simple and safe. Few animals are more readily taken in this way. Several special kinds of traps are in use, but for ordinary purposes the No. 0 steel trap with the spring under the pan will be found as good as any. This is the smallest steel trap made, and is quite an improvement over the ordinary steel trap with side springs, as it is equally strong and much more easily concealed. The trap securely fastened by its chain should be set at the mouth of the hole, lightly covered with fine earth, and baited with almost any kind of grain. Bait is not always necessary, and in the case of a few of the species it is unnecessary even to cover the trap.

## POISONING.

Strychnine and bisulphide of carbon are the most speedy and effective poisons for the destruction of prairie dogs, ground squirrels, and pocket gophers.

*Strychnine.*—In general, the scattering of strychnine about promiscuously is to be avoided on account of the danger to animals other than those for whom it was intended. In certain cases, however, it may be

used to advantage, as shown by the practical experience of Mr. Rollin C. Cooper, of Cooperstown, N. Dak. He writes, under date of November 28, 1888:

"I am farming 7,000 acres, and the gopher question has been one of great interest to me. I now think that I have the best of them and can rid my farm of them at little expense. I send men over my fields about twice in the spring, the first time as soon as the animals commence coming out of their holes, with wheat soaked in strychnine water. I use one ounce of floured strychnine to each bushel of wheat. Every farmer can flour his own strychnine with a caseknife on any piece of iron or glass; it should then be put into quite warm water, dissolving the strychnine fully. Pour on water until the wheat is nicely covered, letting it stand the necessary time. Soak the wheat twenty-four to thirty-six hours, or until somewhat soft. When sufficiently soaked each man takes a teaspoon and a small can and walks over the fields, putting one teaspoonful into each hole. This being carefully done a couple of times each year will soon clean the animals out, and will greatly repay the farmer, even if repeated every year, as one man can go over 50 to 100 acres per day."

Under this head should be mentioned the numerous brands of squirrel poison or squirrel exterminators which have been put on the market during recent years. These consist of grain, usually wheat, prepared with strychnine or other poison ready for use. The different brands have proved of varying value, but several of them have been highly recommended, and in use have proved eminently successful as well as economical.

*Bisulphide of carbon.*—One of the simplest means and probably the most effective and cheapest method yet devised for destroying these animals is by the use of bisulphide of carbon. This compound when pure forms a colorless, mobile liquid having a peculiar odor, and when taken internally is a violent poison. As usually obtained it contains impurities in the form of other compounds of sulphur which give it a strong and extremely offensive odor, and when inhaled it soon causes death. For the purpose of destroying gophers or ground squirrels the crude bisulphide is better and much cheaper than the pure article. Care should be taken in using the liquid, as it is both inflammable and explosive. Its efficacy depends on the fact that its vapor is heavier than air and when introduced into burrows flows like water into all the recesses. This should be borne in mind in using it on sloping ground or in places where there is reason to suppose that the holes contain water, for unless the poison is introduced at the highest opening of the burrow a certain part of the hole will remain free from it and here the animals may take refuge. If the holes contain water, this may act as a water trap preventing the diffusion of the vapor.

The method of use for burrowing mammals is as follows: A small quantity (about 45 cubic centimeters or 3 tablespoonfuls for prairie

dogs, and 30 cubic centimeters or 2 tablespoonfuls for spermophiles and pocket gophers) should be poured upon a bunch of rags or waste, which should be immediately placed within the mouth of the burrow, and the hole closed.

## EXPERIMENTS WITH BISULPHIDE OF CARBON.

A few simple experiments have been made in killing small mammals with bisulphide of carbon. The species upon which the experiments were tried were such as could be readily procured—skunks, prairie dogs, striped spermophiles, pocket gophers, and the common rat. In most cases far too much of the liquid was used, but the object was mainly to determine the quantity necessary to kill animals of various sizes. The animal after being caught in a trap, was fastened by a string and allowed to enter its hole. A measured quantity of liquid bisulphide of carbon was then poured into the hole, the mouth of which was usually covered, and the time required for the animal's death noted. By means of the string they were drawn out of the holes, and if not dead, replaced until they were. Following are some of the experiments:

*Wichita Falls, Tex., August, 1892.*—(1) A prairie dog, fastened by a strong cord, was allowed to enter its hole. It carried down 12 feet 10 inches (3.9 meters) of cord. The hole measured 4 inches (100 millimeters) in diameter. I poured in 49 cubic centimeters of bisulphide (about 3 tablespoonfuls), and in eight minutes drew out the prairie dog, dead.

(2) Another prairie dog fastened by a cord was allowed to enter its hole 8 feet 3 inches (2.5 meters). The hole was $5\frac{3}{4}$ inches (145 millimeters) in diameter. I poured in 49 cubic centimeters of bisulphide and in five minutes drew out the prairie dog, dead.

(3) Another was allowed to go down its hole about 10 feet (3.04 meters). I poured in 49 cubic centimeters of bisulphide, and in five minutes the prairie dog was apparently dead, but caught in the hole, and I broke the string in trying to draw it out.

(4) Another prairie dog with string attached entered its hole 4 feet 3 inches (1.3 meters). Poured in 49 cubic centimeters of bisulphide, and in six minutes drew out the dead prairie dog.

(5) Another with its foot in a trap went down the hole 14 inches (355 millimeters). I poured in 29 cubic centimeters (2 tablespoonfuls), of bisulphide and covered the hole. In five minutes the prairie dog was still alive. The gas had passed by it and filled the lower part of the hole, but had not filled it high enough to reach the prairie dog. From the effects of the gas it was nicely anæsthetized and did not revive for two or three hours.

(6) A Striped Spermophile (*S. tridecemlineatus*) was allowed to go down its hole 14 inches (355 millimeters). Poured in some bisulphide, and in six minutes drew out the spermophile dead.

(7) Caught a skunk by one foot in a steel trap. It had crawled

down a hole the length of the trap chain—about 14 inches (355 millimeters). Eighty-three cubic centimeters of bisulphide was poured into the hole, and in five minutes the skunk was apparently dead, though its heart was still beating. It had not discharged its scent fluid. I handled it freely, rolling it about on the ground, but it could not move. I put it back in the hole, and upon returning three hours later found that it had revived.

*Canadian, Tex., August 28.*—(8) Caught a little spotted skunk (*Spilogale*) in a trap; dug a hole 10 inches (250 millimeters) deep and drew the skunk along till it fell into the hole. After throwing some dry grass over the hole 18 cubic centimeters (about a tablespoonful) of bisulphide was poured on it. In six minutes the skunk was dead and had not discharged its weapon of offense.

(9) A pocket gopher (*Geomys*) was allowed to enter its hole for a distance of 5 feet (1.5 meters). Poured in bisulphide and in five minutes drew out the gopher not quite dead.

*Woodward, Okla., August 29.*—(10) Another pocket gopher entered its hole for a distance of 8 feet (2.4 meters). Poured in 36 cubic centimeters of bisulphide. In six minutes the gopher was not quite dead, and after a time revived.

(11) I let a pocket gopher, with a string attached, enter its hole a distance of 4 feet (1.2 meters) and poured in 29 cubic centimeters of bisulphide. In six minutes it was not dead. I put it back in the hole and in three minutes more took it out dead.

(12) A pocket gopher, with string attached, entered a hole 2 inches (50 millimeters) in diameter, a distance of 10 feet (3 meters). Poured in 44 cubic centimeters of bisulphide. In ten minutes the gopher was not affected. I dug out the hole and not only found that it forked between the animal and the entrance but was packed with fresh dirt, thereby preventing the fumes from being effective.

*Kiowa, Kans., August 31.*—(13) A pocket gopher was placed in a hole 6 inches (150 millimeters) from the entrance and 29 cubic centimeters of bisulphide of carbon poured in. Six minutes later the gopher was only stupefied and soon revived; the gas had passed by and flowed down the hole.

*Washington, D. C.*—(14) Three half-grown brown rats (*Mus decumanus*) were separately placed in a 2-liter glass jar and subjected to various quantities of bisulphide of carbon.

With { 250 cubic centimeters, / 200 cubic centimeters, / 150 cubic centimeters, } the rat died in four minutes.

With 100 cubic centimeters the rat survived.

These experiments were entirely satisfactory so far as properly carried out, but were too few to afford a basis for definite conclusions. The results are shown in the accompanying table:

*Tabular statement showing results of experiments in poisoning small mammals with bisulphide of carbon.*

| No. | Species. | Distance from mouth of burrow. | Diameter of burrow. | Amount of bisulphide. | Time. |
|---|---|---|---|---|---|
| | | *Inches.* | *Inches.* | *Cubic cm.* | *Min.* |
| 1 | Prairie Dog (*Cynomys ludovicianus*) | 154 | 4 | 49 | 8 |
| 2 | .....do | 99 | 5¾ | 49 | 5 |
| 3 | .....do | 120 | ..... | 49 | 5 |
| 4 | .....do | 51 | ..... | 49 | 6 |
| 5 | .....do | 14 | ..... | 29 | (*) |
| 6 | Striped Gopher (*Spermophilus 13-lineatus*) | 14 | ..... | ..... | 6 |
| 7 | Common Skunk (*Mephitis mephitica*) | 14 | ..... | 83 | (†) |
| 8 | Little Spotted Skunk (*Spilogale*) | ..... | ..... | 18 | 6 |
| 9 | Pocket Gopher (*Geomys bursarius*) | 60 | ..... | ..... | ‡5 |
| 10 | .....do | 96 | ..... | 36 | 6 |
| 11 | .....do | 48 | ..... | 29 | 9 |
| 12 | .....do | 120 | 2 | 44 | §10 |
| 13 | .....do | 6 | ..... | 29 | *6 |

*Vapor passed by and did not completely fill burrow. At end of time the animal was anæsthetized, but revived.

† Anæsthetized in five minutes; revived three hours later. ‡Not quite dead. § Not affected.

Prof. E. W. Hilgard, of the University of California, deserves the credit of originating the bisulphide method of destroying burrowing mammals. In a bulletin 'On the destruction of Ground Squirrels by the use of Bisulphide of Carbon,' published in 1878, he gives the results of experiments made on the California Ground Squirrel (*Spermophilus beecheyi*) as follows:

"It is hardly necessary to enlarge upon the importance to California agriculture of devising some ready, safe, and effectual means of putting an end to the constantly increasing inroads of the ground squirrel upon the grain fields and pastures of the State. Unlike most other wild animals, whose range diminishes as culture advances, the ground squirrel finds an improvement of the conditions of its existence as the area of cultivation increases. Each year we hear of its taking possession of 'fresh fields and pastures new,' while rarely loosening its grip upon any district once invaded; and the tax it levies upon the grain-growers of some counties exceeds all the other taxes combined. The damage done during the past season in Contra Costa County alone was estimated by the board of supervisors of that county at not less than $150,000, while in many individual cases from 30 to 50 per cent of the crop was harvested by the squirrels before the reaper could take the field."

After describing the properties of bisulphide of carbon and some of its uses he goes on to say:

"It is curious that in no case have I known a squirrel to run out of the holes before the gas; when it meets it face to face in a run, death seems to be almost instantaneous. But in most cases the animals seem to retire to their nests to die there in a stupor. The mode of proceeding is simply this: Select one or two of the freshest holes in a burrow, introduce into it, as deep down as you can reach, a wide-mouthed ounce vial full of the liquid, upset the vial, and withdraw it. * * * The holes may all be closed at once, with earth, which need not be rammed;

the only object being to keep the gas in, and to see if any of the inmates dig out afterwards. * * * The dead animal is thus buried and out of sight in his own burrow, creates no stench and poisons nothing; its flesh would not be injurious even if dug up. No other wild or domestic animal runs any risk, unless it be the gopher. The holes retain an offensive odor for some time, and remain closed and untenanted. * * * As for the expense of this method, I have freed the most thickly-peopled portions of the University campus (level ground) from every vestige of squirrels with about a pound of the liquid per acre; about half an hour being spent by two men in closing the holes with shovels."*

During the past five or six years this remedy has been recommended by the Division, and has been used with success by numerous correspondents. Mr. Joseph Conaster, of Sunset, Wash., who was much troubled by the depredations of Townsend's Spermophile, after using the poison, wrote under date of July 20, 1892:

"I think your bisulphide will exterminate the squirrels. Have annihilated two towns of them that I have been shooting and poisoning for three years. Did it all in two hours and am satisfied that the bisulphide will be the grand remedy of all."

## KEY TO THE SPECIES.

The area covered by this bulletin includes the ranges of five spermophiles. One of these, Kennicott's Spermophile, is a sub-species of the peculiar Sonoran Spermophile (*S. spilosoma*). A sixth form, the Wyoming Spermophile, closely related to *Spermophilus richardsoni*, will be mentioned and its distribution included under the latter species, as data is wanting to limit the ranges of the two animals.

These five species differ widely from one another in coloration, and may be readily distinguished by the colors and markings of the back. For convenience in identification they are here divided into three groups as shown below.

### KEY TO THE FIVE MISSISSIPPI VALLEY SPERMOPHILES.

1. Back striped lengthwise.
   (*a*) With solid stripes alternating with rows of spots, *Spermophilus tridecemlineatus.*
   (*b*) With rows of spots without any solid stripes.....*Spermophilus mexicanus.*
2. Back irregularly and indistinctly spotted.
   Size small, tail short and slender.....*Spermophilus spilosoma obsoletus.*†
3. Back not distinctly striped or spotted; size large.
   (*a*) Tail long and bushy, gray.....*Spermophilus franklini.*
   (*b*) Tail short, buff below, blackish above.....*Spermophilus richardsoni.*

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* Bulletin of the University of California, No. 32, April, 1878.

† This spermophile inhabits western Nebraska, and is gray in color, with blackish edgings to the spots. It belongs to the *Spermophilus spilosoma* group, most of the members of which are yellowish brown in color. They are not mentioned in the present report because the main part of their range is to the south and west of the area here treated. Representatives of the group however occur in southern and western Texas and eastern Colorado.

# STRIPED PRAIRIE SPERMOPHILE.

**Spermophilus tridecemlineatus** (Mitchill).

[Plate I—Map 1.]

*Description.*—This is the slenderest of the spermophiles, with ears about an eighth of an inch long; the tail is about half as long as the head and body, flattened and slightly bushy. The belly and lower sides, including legs, feet, throat, nose, and lower half of cheeks, are dull buff or ashy buff; the back is striped with six narrow buff colored lines and seven wider lines of dark brown, each brown line inclosing a row of small spots. Along the middle of the back the stripes extend from the top of the head to the tail, becoming shorter on the sides.* Specimens inhabiting the arid plains are considerably paler than those from the prairies of the Mississippi Valley proper, and have been separated as a subspecies under the name *Spermophilus tridecemlineatus pallidus.*

The following measurements were taken from a specimen selected from fifteen adults as representing the average size: Total length from end of nose to tip of tail vertebræ, 252 millimeters (10 inches); length of tail (turned at right angles to back and measured with dividers from angle at base to tip of vertebræ) 88 millimeters (3½ inches); length of hind foot from point of heel to tip of longest claw, 33 millimeters (1¼ inches).

*Range.*—This well-known little animal is widely distributed throughout the central part of North America, ranging continuously from eastern Michigan to Montana and Colorado, and from central Texas north to the plains of the Saskatchewan in Canada, where it reaches latitude 53° N.

Its range embraces all of the five States of North and South Dakota, Iowa, Nebraska and Kansas, and practically all of the Territory of Oklahoma. North of the United States recent observations have failed to carry it beyond Carlton House, Saskatchewan, where it was found more than sixty years ago. Its eastern limit may be indicated by a line following the Red River valley southward to Pembina, N. Dak., and then running diagonally across Minnesota through Crookston, Park Rapids, and Fort Ripley, to the Wisconsin border near Pine City. Wisconsin records are mainly confined to the southeastern part of the State, although it has been found at Sparta and reported as far north as Ripon. In Michigan the northernmost records are Big Rapids, Byers, Palo, and Matherton. *Spermophilus tridecemlineatus* barely enters Ohio and is restricted to the northwestern part of Indiana, not passing east of the Wabash River according to Mr. F. C. Test. The most southern point in Illinois from which it has been reported is Belle Prairie. Harrisville and Golden, Mo., and Ardmore, Ind. Ter., are near its southeastern limits, while Point, Meridian, Clyde, and Epworth, Tex., mark the southern limits of its

* An animal frequently confused with this species is the chipmunk (*Tamias striatus*), which has the middle of the back striped with black, buff, and brown, but no spots, and is further distinguished by a more bushy tail and longer ears. It is a forest animal and climbs trees, while the Striped Spermophile belongs to the prairies and does not climb trees.

distribution so far as known. The western limits of its range are roughly indicated by Fort Garland, Twin Lakes, South Park, and Denver, Colo.; Green River and Douglas, Wyo.; and Fort Custer, Park City, and Chief Mountain Lake, Mont. Specimens have been taken by Mr. E. W. Nelson, at Springerville, Ariz., and the species has been recorded from several places in western New Mexico and Colorado, but the relation of these points to the main area of distribution is not at present clear.

In short, it occupies all of the prairie region east of the Rocky Mountains and is a true prairie-dweller, never entering a timbered region any more than the tree squirrels wander from their forest homes. But as the timber is cleared off and the country brought under cultivation, it frequently follows the fields and spreads to considerable distances from its original haunts. In Michigan forty years ago it was restricted to the few small prairies of the southern part of the State; to-day the southern half of the State is nearly as open as the original prairie country and the spermophiles have spread over it as far north as Big Rapids in Mecosta County. In Minnesota I have observed a similar extension of range, though on a smaller scale. When the timber was removed the spermophiles came in from adjoining prairies and were found about fields previously unoccupied by them. The westward range of the species is limited by the Rocky Mountains, over which they do not pass, although they have penetrated well into the valleys on the east slope and even into some of the mountain parks.

*Habits.*—Throughout the prairies of the Mississippi Valley the little Striped Spermophile is a familiar object as it darts through the grass to its hole, or is seen standing upright on its hind feet, straight and motionless as a stick. With its short ears, smoothly rounded head, and the forefeet drooping at its sides, there is no point about its outline to catch the eye, and at a little distance it is impossible to distinguish it from an old picket pin or tent stake. While hunting spermophiles I have frequently passed what I mistook for a stake only to hear from it a shrill chatter, and as frequently have cautiously approached within 3 or 4 rods of a supposed spermophile before discovering that it was only a peg of wood. Standing thus, the animal will often allow one to approach within a few yards, then quickly dropping on all fours it utters a shrill chatter and dives into a hole close by. Remain quiet for a few minutes, and its head reappears at the entrance of the hole and the little black eyes peer at you curiously. Walk away from the place and it will soon come out and, standing up again, watch you as long as within sight, uttering an occasional note of alarm or warning to its friends. Its note is a rapid trill or trembling whistle, a long drawn-out chur-r-r-r-r in a high key.

Richardson ascribes to this species a quarrelsome disposition, and says: "The manners of the Leopard-marmot are similar to those of *A. richardsoni*, but it is a more active animal and of a bolder and more

irritable disposition. When it has been driven to take shelter in its burrow it may be heard expressing its anger in a shrill and harsh repetition of the syllable *seek-seek.* * * * The males fight when they meet, and in their contests their tails are often mutilated. I observed several individuals which had been recently injured in this way, and it is rare to meet a male which has a tail equaling those of the females in length." (Fauna Boreali-Americana, 1829, p. 177.)

It is not surprising that an animal so characteristic of prairies should not take kindly to trees. I never saw one try to climb a tree, and did not suppose that such an attempt would prove successful, but Mr. Ernest E. Thompson, in writing of their habits, says: "Although the species is supposed to be strictly terrestrial, Mr. R. M. Christie and myself twice observed a gopher climb up a low spruce tree in pursuit of a bay-winged bunting (*Poocœtes gramineus*), that was perched on the top."*

The Striped Spermophile depends for shelter and protection on burrows which it digs in the ground. These burrows are about 2 inches in diameter, descend steeply for a short distance, and then extend off horizontally. Sometimes a hole longer than usual rises nearly to the surface and then dips down siphon-like, leaving a wall between the entrance and the nest. Many of them are short, and seem to be used only to dodge into at the approach of danger, and a bucket of water poured into one will often force out the occupant half drowned and gasping for breath. The tunnels leading to the nests in which the animals spend the winter and raise their young commonly extend 15 or 20 feet, but are not more than a foot, or at most 2 feet, below the surface. Though many of the burrows open on smooth bare ground with nothing to conceal them, the entrances are more commonly hidden by a bunch of grass, and sometimes a dried weed, a piece of paper, or an old rag is drawn over the entrance.

During the breeding season these spermophiles are quiet and shy, but in June and July when the half-grown young begin to make their appearance above ground their voices are most frequently heard. The parent and her young at this time are constantly calling back and forth, and never wander far from one another. The number of young in a litter seems to vary from seven to ten. In some cases higher numbers still have been reported. Mr. W. W. Gilman, of Stoughton, Dane County, Wis., writes that while in Freeborn County, Minn., he examined a number of pregnant females of this species, and found the embryos to number from nine to fourteen. None of those which I have examined contained more than eight embryos, and the number of mammary nipples of the female varied from eight to twelve.

Richardson mentions a female killed, May 17, at Carlton House, on the Saskatchewan River, that contained ten young.†

Mr. Ernest E. Thompson, who has carefully observed the habits of

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* Trans. Hist. and Sci. Soc. of Manitoba, No. 23 (1886), 1887, p. 14.

† Fauna Boreali-Americana, 1829, p. 178.

this species in Manitoba, both in captivity and in a wild state, says that the young are born late in May and usually number eight or nine. Robert Kennicott says: "The young are produced at the end of May or early in June. I have observed from five to nine brought forth at a birth, and I am informed of two instances in which ten were found in a nest; but the number is variable, the usual number being six or seven. The young at birth are naked, blind, and remarkably embryonic. Dr. Hoy, who has observed them in confinement, says that they have no hair on the body before they are twenty days old and the eyes do not open till the thirtieth day. They continue to require nourishment and care of the mother for a much longer period than most rodents. During summer they begin to dig shallow burrows and leave her before winter to shift for themselves. Hibernating mammals require to be in good condition when they retire to winter quarters, which females could scarcely be did they rear young late in the season. This spermophile and probably the rest of the genus produce but one litter a year." (Rept. Comm. Patents for 1856, pp. 76–77.)

*Appearance in spring.*—Towards fall the spermophiles become very fat, and after a few frosty nights, long before snow comes or the ground freezes, they vanish into their holes and do not appear again until the ground thaws in spring. In southern Minnesota they are rarely seen above ground later than the 1st of October or in spring before the 1st of April. Dr. Thomas S. Roberts, of Minneapolis, reports their first appearance in the spring of 1877 on April 5; in 1878, March 17; and in 1879, April 5.

Robert Kennicott says: "To Mr. William Webb, of Fountaindale, Winnebago County, Ill., I am indebted for the following dates of this spermophile's first appearance in spring, as noted in the meteorological register of Mr. Edward Bebb: '1851, April 10; 1852, April 11; 1853, April 2; 1854, March 29; 1855, April 12.'" (Rept. Comm. Patents for 1856, p. 77.) Mr. Plummer L. Ong, of Hennepin, Putnam County, Ill., reports the first one seen at that place in the spring of 1884, on March 24. Mr. O. A. Kenyon, of McGregor, Clayton County, Iowa, reports them as active on April 13, 1887, and Mr. Evelen Brown gives the dates of their first appearance at Bathgate, Pembina County, N. Dak., as March 29, 1889, and April 16, 1890. At Beloit, Kit Carson County, Colo., Mr. H. G. Hoskin reports their first appearance in the spring of 1890 on March 10. In Manitoba Mr. Ernest E. Thompson reports their first appearance at Carberry in spring about April 20, and says that they are not seen after the 1st of October.*

Whether they remain dormant all of the six or seven months which are spent underground is difficult to determine, but it seems probable that they do not. Large stores of grain and nuts are carried into the holes in autumn and stored close to their nests. Whether these are

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* Rept. Dept. Agl. and Statistics, Prov. of Manitoba, 1882, pp. 169-172.

eaten during the winter or saved for use in the spring when grain and seeds are scarce remains to be ascertained.

*Hibernation.*—The observations of the late Dr. P. R. Hoy on the hibernation of this spermophile add much to our knowledge not only of its habits but to the subject of hibernation.

He states: "The following are the results of many observations and experiments on the Striped Gopher (*Spermophilus tridecemlineatus*) during active life as well as when under the profound stupor of hibernation. During activity the gopher's pulse is 200; respiration, 50; temperature, 105.

"On the second of October, having procured a Red Squirrel (*Sciurus hudsonicus*) and a gopher, animals of nearly equal size, the one active during the coldest weather, while the other is a characteristic hibernator, I cut out a part of the gluteal muscles of each, and after dividing and bruising, so as thoroughly to break up every part, I took 50 grains of each and placed in a test tube, into which I put 2 ounces of cold water. After freely agitating, the mixture was left to digest for eight hours, at the expiration of which time I carefully decanted and renewed the water, agitated and left twelve hours, then filtered and rolled the residuum on blotting paper, in order to remove all excess of moisture. When weighed they stood: gopher, 50–15; squirrel, 50–10. These experiments were repeated with substantially the same results. Gluteal muscles of the squirrel contained 20 per cent of albumen, soluble in cold water, while the same muscles of the Striped Gopher treated in like manner, at the same time, yielded 30 per cent.

"As it is well known that the flesh of reptiles is rich in albumen, I procured several marsh frogs and subjected the gluteal muscles to like analysis, which resulted in 40 per cent of loss. The following will convey to the eye these results:

Per cent of soluble albumen: Frog, 40; gopher, 30; squirrel, 20.

"On the 15th of December, the gopher being thoroughly torpid, temperature of the room 45, gopher rolled up like a ball, no visible evidence of life, I opened the abdomen and inserted the bulb of a thermometer which indicated 58°. I next turned back the sternum in such a manner as to expose the heart and lungs. The remarkably congested condition of these organs first attracted my attention; in fact, it would appear as if all the blood had collected within the thorax. The pulsation of the heart was reduced to four each minute, the auricles would slowly and imperfectly contract, followed immediately by the ventricles. These slow pulsations of the heart occupied four seconds. There was no visible respiration, the lungs remaining almost entirely passive. The heart continued to pulsate, without perceptible change, for fifteen minutes, and then when raised from its position it continued to pulsate for some time, being almost reptilian in this respect. During hibernation the circulation is so feeble that when a limb is amputated but a few drops of blood will slowly ooze from the fresh wound. The stomachs

and bowels empty, and the body was inclosed in a thick adipose layer. I was not able to excite the least motion or contraction of the muscles in any way, even by pinching or cutting nerves, showing the most perfect condition of anæsthesia possible.

"During hibernation the gopher is not able to endure more than 6° or 8° of frost. The manifestations of life are so feebly performed that a few degrees below freezing is sufficient to convert apparent death into the reality. On the 10th of April, at which time the first gopher appeared above ground, I repeated the experiment of the previous autumn. Body emaciated, hair dry and lifeless, flesh perceptibly less moist than it was in the fall. On subjecting the gluteal muscles to like treatment as in October, I was surprised to find only 18 per cent of loss instead of the 30, as exhibited in the previous autumn.

"The large amount of soluble albumen found in the flesh of the Striped Gopher in the fall, and the lesser amount found after its protracted hibernation, go far to prove that albumen somehow fits the animal for its long sleep. Is it not probable that albumen is a stored-up magazine of elaborated nutrition to be used when no food can be assimilated by the digestive organ?"*

## INJURY TO CROPS.

Many replies have been received to letters sent out by the Division of Ornithology and Mammalogy inquiring as to the injury done by Striped Spermophiles and other species in the Mississippi Valley. Reports from correspondents in all the States where these animals occur agree that they cause serious damage to the crops. The following extracts from letters will give some idea of the extent and nature of their ravages.

*Minnesota.*—Mr. George Little, county treasurer of Lyon County, reports: "Striped Gophers increase or decrease very rapidly according to favorable or unfavorable conditions. A succession of dry years is especially favorable to their increase, while a succession of wet seasons reduces their numbers very rapidly, probably by flooding their nests. They have been very numerous this season [1888] and very destructive to corn immediately after planting; whole fields, in some instances, have been entirely destroyed, and it is a rare thing to see or hear of a field that has not been damaged." Peter Skoglund, of Lake Andrew, Kandiyohi County, writes under date of November, 1889: "The common Striped and Gray Gophers do more injury to our grainfields than any other mammals. They begin before the grain ripens, cutting down, consuming, and storing away for winter use. I have lost about 20 bushels from this cause."

*Iowa.*—In Butler County Mr. W. Head, of Bristow, writes under date of January 5, 1887: "The common Striped Ground Squirrel or Gopher

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*Proc. Am. Ass. Adv. Sci. Aug. 1875, pp. 148–149.

is a great pest on the farm. When corn is just peeping through the ground they will follow a row and pull up the hills and eat off the kernel. Last year I found the hills pulled up for rods in one place. They are also destructive to wheat. My father had a wheatfield by the side of a new piece of ground which was full of gopher burrows. I was set to trapping them and found in their holes heads of wheat which had been entirely shelled out. The breaking was strewn with straws and wheat heads which had been shelled out and the grain carried into their holes." Mr. John N. Houghton, of Grinnell, Poweshiek County, says (March 23, 1891): "*Spermophilus tridecemlineatus* is very abundant. During the past summer I have seen twenty-five during a walk of a quarter of a mile. As to its destructive traits, it is prominent chiefly in destroying young corn. * * * The past summer it destroyed a half acre in a piece of 4 acres belonging to me. I have seen it catch and consume the cabbage butterfly repeatedly, and have also watched it digging for cutworms. These are cases of traits beneficial to the farmer, I am positive."

*Nebraska.*—Mr. Lawrence Bruner, of Lincoln, reports three species present, *Spermophilus tridecemlineatus*, *S. spilosoma obsoletus*, and *S. franklini*, of which the first is by far the most common and very destructive to young corn. In Buffalo County Mr. R. W. Thatcher, of Gibbon, says: "The Striped Gopher, 'Line-tailed Spermophile'* and badger are all destructive to grain. The first two are very much more common this year than ever before. They work much alike and mostly upon corn, digging down to the seed and then eating it. They have been known to follow the planter and dig up every hill for several rods. They do not stop when the corn sprouts, but continue to dig until the seed has all been absorbed. Formerly they lived in holes on the prairie, and worked only on the edge of a field, but this year [1888] they have dug their holes in the fields, eating the corn all around them. They occasion great damage to the corn crop and are killed mercilessly by all the farmers. We have a field of corn which was planted May 23. Owing to the cold, backward spring it was late in coming up, and we could not begin working it until June 9. During the first day's work I counted the number of hills dug up in several rows. I found the average to be about forty-five hills to the row of 120 rods. The next time I was at work I saw a gopher catch and kill a field mouse, which is something I have never seen them do before. I do not know what caused the gopher to do so, for as soon as I approached it, it dropped the mouse and ran into its hole. The mouse was badly bitten." [Letter dated June 19, 1888.]

From Turlington, Otoe County, Mr. William N. Hunter writes: "The Striped Gopher (*Spermophilus tridecemlineatus*) is the worst enemy of

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* The true Line-tailed Spermophile (*Spermophilus grammurus*) is a Rocky Mountain species and does not occur in Nebraska. The species here referred to is undoubtedly Franklin's Spermophile (*S. franklini*). Gibbon is near the western limit of its range.

the farmer in this county during the time of corn planting, digging up large amounts of corn just after it is planted. I know of one instance this spring where a farmer had to plant over 10 acres, so completely had the gophers destroyed the field. In spite of the constant warfare on these gophers by farmers they continue to increase. I found one female that would have produced twelve young, and seven to ten is a common average." [Letter dated May 29, 1891.]

*Kansas.*—In Kansas Mr. George Briggs, of Reeder, reports that in Kiowa County, Striped Gophers live on the prairie around the edge of the fields and dig up seed corn in the spring. Patches of from 1 to 5 rods in extent were destroyed around the outside of all the cornfields in the neighborhood of Reeder in 1888, and the damage was so great that in some cases the farmers had to replant. Prof. L. L. Dyche, of Lawrence, Douglas County, writes: "The Ground Squirrel (*Spermophilus tridecemlineatus*) digs up corn, squash, melon, and other seeds soon after they are planted. Farmers say that these Ground Squirrels can smell the seeds, for they always dig straight down to them. Some watermelon farmers report that the squirrels frequently stop the growth of a vine by nibbling or cutting off the tender runners near the end. Cases were reported where they cut holes in the nearly ripe muskmelons and watermelons and ate the seed out."

*Colorado.*—Mr. Horace G. Smith, jr., of Denver, writes under date of September 16, 1888: "I have resided some fifteen years in Denver. The Striped Gopher (*Spermophilus tridecemlineatus* or an allied species) is common everywhere on the plains and is occasionally seen in timber along the streams. It does more or less damage by digging up seeds, particularly corn and melons. They skip about over the field, digging up a hill here and there. I have known instances where it was necessary to replant melons in order to get a stand, though three or four times the required seed was planted the first time. These spermophiles are easily killed by placing poisoned grain at the entrances to their burrows. Their natural food seems to be grasshoppers, grass, and leaves of other plants, seeds, etc. The cactus furnishes a large amount of food for them; the cap of the ovary is cut away, exposing a thimbleful of seeds on which they feed. I have seen them occasionally in the top of *Psoralea lanceolata*, a bushy plant of the pea family, on the seeds of which they feed.

"I have found the feathers of the shore lark (*Otocoris alpestris arenicola*) about the entrance to their burrows on one or two occasions, but whether killed by the squirrel or not I do not know, though I have known it to turn cannibal when several were kept together in confinement. The shore lark evidently regards them as enemies, for I have often seen them try to drive the spermophiles from the locality of their nests, and have found the eggs of this species, as well as those of the lark bunting (*Calamospiza melanocorys*), destroyed, as I supposed, by this spermophile."

## FOOD.

The name *Spermophilus*, meaning seed-lover, is particularly appropriate for this species. Scarcely a seed or grain grows where they live that they do not eat. The following list includes only such as I have seen them in the act of eating or have found in their cheek pouches or stomachs: Wheat, oats, barley, rye, corn, acorns, hazelnuts, seeds of mountain rice (*Oryzopsis micrantha*), feather grass (*Stipa spartea*), pigeon grass (*Setaria*), millet (*Setaria italica*), wild sunflowers (*Helianthus*), pigweed (*Chenopodium*), bindweed and knotweed (*Polygonum*), puccoon (*Lithospermum*), three species of prickly pear (*Opuntia missouriensis*, *O. fragilis*, and *O. rafinesqui*), ragweed (*Ambrosia*), buffalo peas (*Astragalus caryocarpus*), *Hosackia purshiana*, and common locust (*Robinia pseudacacia*). But their food is by no means restricted to seeds, for they are fond of various fruits, roots, insects, lizards, mice, and any kind of fresh meat. They eat the fruit of the prickly pear (*Opuntia rafinesqui*), strawberries, green foliage of numerous plants, roots of sorrel (*Oxalis violacea*), and wild larkspur (*Delphinium azureum*).

Animal food forms a part of their diet and they feed especially upon such insects as grasshoppers, beetles, caterpillars, and ants. They seem to like any kind of fresh meat and have troubled me a great deal by eating small mammals caught for specimens. In traps set with much care for various kinds of mice (*Sitomys*, *Perognathus*, or *Arvicola*), I have frequently found only the strips of skin with feet and tail attached to show where a rare specimen had disappeared; and on opening the stomach of the spermophile caught near the place have found in its stomach the flesh of the lost specimens. Moreover, they are true cannibals, devouring the dead bodies of their own species. They tear the skin in strips and eat out the flesh. Mice are usually eaten bones and all, and frequently nothing but bits of torn skin and the feet and tail are left. I once shot a spermophile as it was sitting up eating something that it held in its paws. On picking it up a partly devoured lizard (*Eumeces fasciatus*) was found, and several joints of the lizard's tail were in the spermophile's cheek pouches. Prof. F. E. L. Beal informs me that at Ames, Story County, Iowa, he once saw a Striped Spermophile with a large hairy caterpillar in its mouth, and on another occasion saw one carrying a field mouse.

Prof. Herbert Osborn, of Ames, Iowa, contributes the following interesting account of their food habits: "Early in June I noticed the Striped Ground Squirrels on the college lawn digging into the turf and eating something which they withdrew. Examining the places thus dug up I always found the peculiar cocoon of a *Crambus*, and the place would also show the deserted web and burrow of the larva. These squirrels' burrows were very numerous in some parts of the lawn; and in one place I counted twenty-five in the space of a square yard,

indicating that the ground squirrel had disposed of that many larvæ or pupæ of *Crambus* within the given area. At another time I counted fifty to the square yard. Evidently when sodworms are plenty the ground squirrel is not an unmixed evil." (Ann. Rept. U. S. Dept. Agriculture, 1887, p. 155.)

Prof. C. P. Gillette, in Bulletin No. 6 of the Iowa Experiment Station, published in 1889, gives the results of the examination of twenty-two stomachs of this spermophile, made at Ames, Iowa. The animals from which the stomachs were taken were killed on various parts of the college farm, and at intervals from April 19 to August 2. As a result of this examination it was found that insects formed 46 per cent of the stomach contents, with an average number of thirteen cutworms and webworms in each. "The webworms in these stomachs were, in the great majority of cases, the larvæ of *Crambus exsiccatus* which is very injurious to corn and grass in Iowa, its work in corn being very often mistaken for that of cutworms." In conclusion it is stated that "the insects which the squirrels feed on are almost exclusively injurious species, chief among which seem to be cutworms, webworms, and grasshoppers. As grass, clover, and other green stuff has been abundant wherever the squirrels were taken, and as their stomachs were often gorged with insects that must have given them much trouble to catch, it would seem that they prefer the latter food" (page 242).

In Bulletin No. 30 of the Agricultural College and Experiment Station of Brookings, S. Dak., are given the results of an examination, by J. M. Aldrich, of the contents of fifteen stomachs of the Striped Spermophile. As relative amounts of the different materials found in the stomachs are not given, it is impossible to compare the results with those of other examinations. The stomachs were taken from animals killed from June 19 to 23: "June 19 and 22, corn was well up, but the planted kernels were still in condition to invite the gophers. There were few ripe seeds of any kind, so that the stomach contents were generally classified into insects, corn, and 'green stuff,' the last being apparently grass and other plants, a mixture difficult to analyze and not of great importance from our standpoint. The corn was readily distinguishable, while the insects were usually represented by legs, antennæ, elytra, and other hard parts, more or less fragmentary. In the case of cutworms and other larvæ, the whole or a large piece of the skin was generally found, the soft parts having been crushed out. It was not possible, as a general thing, to make out the species of the insect, but the genus or family is sufficient to indicate pretty well whether the species is injurious or not.

"Nos. 1 to 7 were killed on the afternoon of June 19 between 1:15 and 4:30.

"*No. 1.*—In the road near the corner of pasture. Only grass and small grain in the immediate vicinity. Stomach quite full, mostly

grain, a little green stuff, and remains of at least one beetle (probably carabid). Another gopher near this one was observed to pick grain out of horse manure in the road.

"*No. 2.*—Near No. 1. Stomach not very full; grain and grass; one beetle (*Chrysomela*).

"*No. 3.*—Near a little stream. Tall grass and weeds all around. A young gopher, two-thirds grown; stomach half full of green stuff; remains of one beetle (*Harpalus?*).

"*No. 4.*—By an old straw stack; weeds, potatoes, and pasture near by. Stomach very full, mostly grain and seeds; about one-third beetles (carabid, and perhaps chrysomelid).

"*No. 5.*—Also killed by the straw stack; stomach full; more grass than No. 4; one beetle (carabid).

"*No. 6.*—Same place; stomach full, mostly green stuff; several beetles, three pieces of skin of lepidopterous larvæ, of which two seemed to be cutworms.

"*No. 7.*—Same place; stomach full; grain, grass, one cricket, two beetles (chrysomelid and carabid).

"The next four gophers were killed June 22, between 9.15 a. m. and 1 p. m.

"*No. 8.*—At edge of grass plat, 10 rods from cornfield. Cheeks full of corn. Stomach full, two-thirds corn, rest insects; one beetle, one cricket (?), about six cutworms.

"*No. 9.*—At edge of creek. Stomach nearly empty; one lepidopterous larva, not a cutworm; one or two beetles (*Chrysomela*); the rest vegetable.

"*No. 10.*—Same place (40 rods from cornfield). Stomach moderately full of corn; one beetle (carabid?).

"*No. 11.*—Same place. Stomach full; mostly insects, numerous beetles (carabid and chrysomelid), one grasshopper, one larva, not cutworm.

"The remaining four were killed June 23, about noon.

"*No. 12.*—At edge of timothy field, near millet, 30 rods from corn. Stomach moderately full, half corn, a little grass, about four cutworms, two or three chrysomelid and as many carabid beetles, one grasshopper.

"*No. 13.*—On campus, grass all around. Stomach moderately full; one-third grass, the rest insects. About eight lepidopterous larvæ, of which one or more were cutworms.

"*No. 14.*—In raspberry patch. Stomach full, mostly corn and grain; one grasshopper; three cutworms; one carabid beetle.

"*No. 15.*—In road not a great distance from cornfield. Stomach full; half full, corn; one beetle; three or four lepidopterous larvæ, of which two were cutworms.

"Summing up the insects, we have nineteen or twenty cutworms, eleven other lepidopterous larvæ, three grasshoppers, and two crickets.

all of which may be set down as injurious. The number of beetles of all kinds could not be definitely ascertained, but was thirty to thirty-five. None of them were species which are noted either for benefiting or injuring the farmer. Those marked carabid and *Harpalus* belong to a family that are generally beneficial, while those marked chrysomelid and *Chrysomela* belong to the leaf-eaters, of which group many species are injurious. As the beetles found in the gophers' stomachs were of both classes, there is no great preponderance on either side" (pp. 9–11).

Undoubtedly the good which the Striped Spermophiles do by destroying insects, and seeds of noxious weeds is of no small importance, but it is doubtful if it is sufficient to offset the damage perpetrated by them in grain fields. In many localities it is impossible to raise a full field of corn without first killing the spermophiles. As soon as the corn is planted they begin to dig up the seed, but do most mischief after the corn begins to come up and until a week or ten days old, or until all the nutriment is drawn from the grain. They dig down by the side of the stalk and eat the swollen, starchy grain, of which they seem very fond, leaving the stalks to die. As a single spermophile will dig up many hills of corn in a day and continue digging for nearly two weeks, it is not difficult to see that serious damage is done where they are numerous, averaging as they often do four or five to an acre. Large fields of corn are sometimes entirely destroyed by them and have to be planted over several times. A great deal of wheat, oats, barley, and rye is taken in the same way, making it necessary to sow an extra amount of seed. Even this means is not effectual, and frequently fields of sowed grain suffer materially from their attacks. As the small grains begin to fill soon after blossoming the spermophiles cut down the stalks and eat the ovules, and in order to find the best heads they cut down a great deal more than they eat. As the grain becomes hard they carry large stores of it into their burrows to be eaten at leisure, probably when they awake from their winter's sleep. The amount of damage done depends upon the abundance of the animals, and is often serious. If a field is small and isolated the spermophiles sometimes collect and destroy almost the whole crop.

Dr. A. K. Fisher in notes on this species and Franklin's Spermophile says: "Where abundant, as they are in many parts of the West, they destroy large quantities of corn, wheat, oats, and the seeds of flax. They also feed to some extent on the seeds of wild plants, even when grain is plenty. A Striped Gopher shot at Heron Lake [Minn.], near a field of wheat stubble had its pouches full of the seeds of the ragweed (*Ambrosia artemisiæfolia*). "In view of the fat that large numbers of these animals are shot and handled it is surprising that they are not used as an article of food. Their flesh is as sweet and delicate as that of the arboreal squirrels, which are held in high esteem as a game dish in many parts of

the East. The farmers agree that they ought to be good to eat, but it was impossible to learn of any one who had tried them." (Annual Report Dept. Agriculture, 1887, pp. 455–456.)

In studying the food of the Striped Spermophile eighty stomachs and eleven cheek pouches were collected and their contents carefully examined. Since the stomachs were taken from specimens collected at various dates, ranging from May 19 to August 31, and over an extent of country including Minnesota, the Dakotas, Montana, Wyoming, Kansas, and Texas, it may be reasonably inferred that the average summer diet of the species is represented. Following is a list of the food components found in the stomachs:

| ANIMAL. | VEGETABLE. |
|---|---|
| Grasshoppers. | Oats. |
| Crickets. | Wheat. |
| Caterpillars (larvæ of Lepidoptera). | Pig-weed (*Chenopodium*). |
| Beetles. | Bind-weed seeds (*Polygonum*). |
| Ants. | Wild sunflower seeds (*Helianthus*). |
| A small cocoon. | Nightshade berries (*Solanum*). |
| Insects' eggs. | Cactus fruit (*Opuntia*). |
| Spermophile hairs. | Roots. |
| Feathers of small birds. | Herbage. |

The number of feathers was not sufficient to prove that birds had been eaten. The spermophiles may have picked up stray feathers to line their nests with and in carrying them home accidentally swallowed a few. Still, from their well-known carnivorous habits, it seems most probable that wounded or dead birds had been found and eaten. Most of the hairs in the stomachs seemed to have come from the animals themselves and were probably swallowed by accident.

*Summary.*—Of the total contents of the eighty stomachs examined, more than half consisted of insects. The percentage of animal matter was 52.9; of vegetable matter 44.4; and of indeterminate matter 2.7. The cheek pouches contained 100 per cent of vegetable matter, being filled exclusively with grain and seeds of various plants.

*Table showing contents of 80 stomachs of the Striped Prairie Spermophile (Spermophilus tridecemlineatus).*

| Cat. No. | Sex. | Date. | Locality. | Percentage of animal matter. | Percentage of vegetable matter. | Contents. |
|---|---|---|---|---|---|---|
| | | 1887. | | | | |
| 13 | ♀ | May 19 | Heron Lake, Minn.... | 3 | 97 | Small insects; shell of little striped beetle; oats, seeds, herbage. |
| 14 | ♂ | May 19 | .....do..... | 10 | 90 | Beetles; chewed vegetable fiber; pulp, and shells of seeds. |
| 15 | ♂ | May 19 | .....do..... | 25 | 75 | Beetles; one small striped beetle; vegetable matter, and seeds. |
| 16 | ♂ | May 21 | .....do..... | 70 | 30 | A beetle; a coleopterous larva; other insects; vegetable matter. |
| 17 | ♀ | May 21 | .....do..... | 100 | ..... | Insects. |
| 18 | ♀ | May 21 | .....do..... | 100 | ..... | Crickets; larvæ, apparently of bumblebees. |

*Table showing contents of 80 stomachs of the Striped Prairie Spermophile (Spermophilus tridecemlineatus)*—Continued.

| Cat-No. | Sex- | Date. | Locality. | Percentage of animal matter. | Percentage of vegetable matter. | Contents. |
|---|---|---|---|---|---|---|
| | | 1887. | | | | |
| 19 | ♂ | May 27 | Flandreau, S. Dak .... | 30 | 70 | Beetles and other insects; seed pulp, and hulls. |
| 20 | ♂ | May 27 | .....do ..... | 30 | 70 | About 18 coleopterous larvæ; grain; herbage. |
| 21 | ♀ | May 27 | .....do ..... | 25 | 75 | Some small cocoons; seed shells. |
| 53 | ..... | June 9 | Ortonville, Minn..... | 80 | 20 | Beetles; grasshoppers; caterpillars; vegetable matter. |
| 55 | ..... | June 9 | .....do ..... | 50 | 50 | Coleopterous and other larvæ; grain; vegetable matter. |
| 62 | ♂ | June 11 | .....do ..... | 25 | ..... | Particles of insects; dirt. |
| 81 | ♀ | June 24 | Browns Valley, Minn. | 75 | 25 | Grasshoppers; trace of beetles; some remains of grain. |
| 84 | ♂ | June 27 | .....do ..... | 5 | 95 | A few bits of ants and other insects; herbage, and grain shells. |
| 100 | ♀ | June 30 | .....do ..... | 40 | 60 | Grasshoppers; beetles; larvæ; insect eggs; seeds; herbage. |
| 103 | ♀ | July 1 | .....do ..... | 10 | 90 | Grasshoppers; beetles; ground-up seeds. |
| 109 | ♂ | July 2 | Travare, S. Dak..... | 20 | 80 | Pieces of 3 larvæ of insects; grasshoppers, and grain. |
| 112 | ♂ | July 4 | .....do ..... | 2 | 98 | Grasshopper; vegetable fiber, and seed pulp. |
| 115 | ♀ | July 5 | .....do ..... | 30 | 70 | Beetles; grasshoppers; grain; herbage. |
| 116 | ♂ | July 5 | .....do ..... | 50 | 50 | Beetles; grasshoppers; shells and pulp of seeds. |
| 125 | ♂ | July 7 | .....do ..... | 50 | 50 | Grasshoppers; caterpillars; trace of beetle; bark or roots. |
| 126 | ♀ | July 7 | Browns Valley, Minn. | 25 | 75 | Grasshoppers; beetles; seeds of *Polygonum*. |
| 127 | ♂ | July 8 | Travare, S. Dak..... | 30 | 70 | Grasshoppers; crickets; other insects; grain; roots. |
| 139 | ♂ | July 18 | Grand Forks, N. Dak. | ..... | 100 | A little finely chewed wheat or oats. |
| 143 | ♀ | July 18 | .....do ..... | ..... | 100 | A few bits of oat hulls and skin of grains. |
| 144 | ♂ | July 18 | .....do ..... | 50 | 50 | Bits of small insects and seeds. |
| 145 | ♂ | July 18 | .....do ..... | 4 | 96 | 1 grasshopper; oats. |
| 149 | ♀ | July 22 | Pembina, N. Dak ..... | 100 | ..... | Insects, mostly grasshoppers. |
| 152 | ♂ | July 23 | .....do ..... | 60 | 40 | Grasshoppers; wheat. |
| 162 | ♂ | July 25 | .....do ..... | 25 | 75 | Insects; wheat. |
| 163 | ♀ | July 26 | .....do ..... | 50 | 50 | Grasshoppers; finely chewed seeds. |
| 170 | ♂ | July 26 | .....do ..... | 90 | 10 | Grasshoppers; a little grain. |
| 179 | ♀ | July 28 | .....do ..... | 3 | ..... | Hair of *Spermophilus tridecemlineatus* and some indeterminate matter. |
| 185 | ♂ | July 28 | .....do ..... | 100 | ..... | Insects; ants; small beetles; pupæ of ants(?). |
| 186 | ♀ | July 28 | .....do ..... | 100 | ..... | Insects only; mostly grasshoppers. |
| 194 | ♂ | July 30 | .....do ..... | 80 | 20 | Mostly grasshoppers; some vegetable matter. |
| 203 | ♂ | Aug. 2 | .....do ..... | 100 | ..... | Insects, mostly grasshoppers. |
| 206 | ♀ | Aug. 8 | Devils Lake, N. Dak .. | 100 | ..... | Crickets; small beetles; grasshoppers. |
| 207 | ♂ | Aug. 10 | .....do ..... | 2 | 98 | Insects; wheat; some small seeds. |
| 211 | ♀ | Aug. 12 | .....do ..... | 75 | 25 | Mostly grasshoppers; grain; herbage. |
| 212 | ♀ | Aug. 12 | .....do ..... | 95 | 5 | Insects; grasshoppers; ants; herbage. |
| 216 | ♂ | Aug. 13 | .....do ..... | 50 | 50 | Grasshoppers; hair; grain; herbage. |
| 221 | ♀ | Aug. 15 | .....do ..... | 100 | ..... | Insects, mostly grasshoppers. |
| 224 | ♀ | Aug. 16 | .....do ..... | 50 | 50 | Grasshoppers; other insects, grain; herbage; *Solanum* seeds and berries. |
| 232 | ♀ | Aug. 23 | Bottineau, N. Dak.... | 90 | 10 | Insects; grasshoppers; ants; small beetles; larvæ; 1 feather; hairs; vegetable matter. |
| 242 | ♀ | Aug. 24 | .....do ..... | 100 | ..... | Grasshoppers. |
| 259 | ♂ | Aug. 29 | .....do ..... | 50 | 50 | A few insects; hairs; indeterminate vegetable matter. |
| 265 | ♂ | Sept. 6 | Fort Buford, N. Dak.. | 80 | 20 | Mostly grasshoppers; seeds of *Helianthus* and *Chenopodium*. |

*Table showing contents of 80 stomachs of the Striped Prairie Spermophile (Spermophilus tridecemlineatus)*—Continued.

| Cat. No. | Sex. | Date. | Locality. | Percentage of animal matter. | Percentage of vegetable matter. | Contents. |
|---|---|---|---|---|---|---|
| | | 1887. | | | | |
| 266 | ♂ | Sept. 6 | Fort Buford, N. Dak. | 40 | 50 | Insects; green herbage; 10% indeterminate matter. |
| 284 | ♂ | Sept. 14 | ....do.... | 90 | 10 | Mostly grasshoppers; a few *Helianthus* seeds. |
| 289 | ♀ | Sept. 16 | ....do.... | 25 | 75 | Grasshoppers; green foliage; *Helianthus* seeds. |
| 304 | ♂ | Oct. 5 | Dawson County, Mont. | 50 | 50 | Grasshoppers; seeds of *Helianthus* and of probably *Mammilaria*. |
| | | 1888. | | | | |
| 377 | ♀ | May 21 | Pierre, S. Dak..... | 50 | 50 | Grasshoppers; wheat. |
| 378 | ♀ | May 21 | ....do.... | 10 | 90 | Insects; seeds; herbage. |
| 379 | ♂ | May 23 | ....do.... | 20 | 80 | Grasshoppers; grain; herbage. |
| 386 | ♂ | May 25 | ....do.... | 20 | 80 | Grasshoppers; *Polygonum* seeds. |
| 419 | ♂ | June 28 | Buffalo Gap, S. Dak.. | 100 | ..... | Grasshoppers; perhaps other insects; 1 small feather. |
| 429 | ..... | July 3 | ....do.... | 95 | 5 | Insects; crickets; 4 species of beetles; vegetable matter. |
| 444 | ♀ | July 16 | Custer, S. Dak..... | 50 | 50 | Grasshoppers; other insects; seeds; other vegetable matter. |
| 477 | ♀ | Aug. 20 | Cheyenne, Wyo ..... | 25 | 75 | A few grasshoppers; 1 black beetle; *Chenopodium* seeds; green stuff. |
| 481 | ♀ | Aug. 21 | ....do.... | 25 | 75 | Grasshoppers; 1 larva or pupa; indeterminate herbage and seeds. |
| 482 | ..... | Aug. 21 | ....do.... | 50 | 50 | 1 ant; 1 small beetle; grasshoppers; *Chenopodium* remains; other plants and seeds. |
| | | 1892. | | | | |
| | ♀ im. | July 12 | Golden City, Mo..... | 20 | 80 | Wheat and small beetles. |
| | ♀ im. | July 12 | ....do.... | 30 | 70 | A grasshopper; flowers and herbage. |
| | ♂ im. | July 12 | ....do.... | 40 | 60 | A grasshopper and wheat. |
| | ♀ | July 26 | Belle Plaine, Kans.... | 100 | ..... | 1 large grasshopper and its eggs. |
| | ♀ | Aug. 2 | Garden Plain, Kans .. | 75 | 25 | Grasshoppers; beetles; wheat. |
| | ♂ | Aug. 16 | Wichita Falls, Kans.. | 75 | 25 | Grasshoppers and seeds. |
| | ♀ | Aug. 17 | ....do.... | 80 | 20 | Grasshoppers; 1 cricket; purslane leaves. |
| 3867 | ♂ | Aug. 23 | Washburn, Tex ..... | 100 | ..... | Do. |
| 3868 | ♂ | Aug. 23 | ....do.... | 50 | 50 | Grasshoppers and oatmeal (used for trap bait). |
| 2869 | ♂ | Aug. 23 | ....do.... | 90 | 10 | Do. |
| 3871 | ♀ | Aug. 23 | ....do.... | 100 | ..... | Grasshoppers. |
| 3872 | ♂ | Aug. 23 | ....do.... | 60 | 40 | Grasshoppers and cactus fruit. |
| 3895 | ♂ | Aug. 31 | Kiowa, Kans ..... | 40 | 60 | Insects and seeds. |
| 3896 | ♀ | Aug. 31 | ....do.... | 50 | 50 | Grasshoppers; small insects and seeds. |
| 3897 | ♀ | Aug. 31 | ....do.... | 20 | 80 | Small insects and seeds. |
| 3898 | ♀ | Aug. 31 | ....do.... | 100 | ..... | Grasshoppers. |
| 3899 | ♀ | Aug. 31 | ....do.... | 50 | 50 | Grasshoppers; other insects, and seeds. |
| | ♂ | Aug. 31 | ....do.... | 80 | 20 | Grasshoppers; small beetles; larvæ of insects; seeds. |

The following tables show that the contents of the cheek pouches differ widely from those of the stomachs, many things being eaten that are never stowed away in the pouches. For instance, more than half of the stomach contents consisted of insects, while no insects were found in the cheek pouches, the latter invariably containing nothing but seeds. This is what might be expected, as the food laid up for winter is carried in the cheek pouches.

*Table showing contents of cheek pouches of 11 Striped Prairie Spermophiles (Spermophilus tridecemlineatus).*

| Cat. No. | Sex. | Date. | Locality. | Percentage of animal matter. | Percentage of vegetable matter. | Contents. |
|---|---|---|---|---|---|---|
| | | 1887. | | | | |
| 84 | ♂ | May 27 | Browns Valley, Minn. | ..... | 100 | 43 grains of wheat; 400 seeds of millet; 2 seeds of *Stipa spartea;* 1 seed of Polygonum. |
| 100 | ♀ | May 30 | .....do ..... | ..... | 100 | Seeds of *Lithospermum.* |
| 137 | ♀ | June 14 | Harwood, N. Dak ..... | ..... | 100 | 71 grains of oats. |
| 145 | ♂ | June 18 | Grand Forks, N. Dak . | ..... | 100 | 31 grains of oats. |
| 265 | ♂ | Sept. 6 | Fort Buford, N. Dak.. | ..... | 100 | 127 seeds of *Helianthus.* |
| | | 1888. | | | | |
| 424 | ♂ | July 3 | Buffalo Gap, S. Dak... | ..... | 100 | Seeds of a *Stipa.* |
| | | 1890. | | | | |
| | ..... | Oct. — | Fort Snelling, Minn .. | ..... | 100 | 1,388 seeds of bindweed; 30 seeds of pigeon grass; 4 seeds of panic-grass (coll. by Dr. E. A. Mearns). |
| | ..... | ..... | .....do ..... | ..... | 100 | 1,075 seeds of ragweed; 95 seeds of bindweed; 110 seeds of panic-grass (coll. by Dr. E. A.Mearns). |
| | | 1889. | | | | |
| 2 | ♂ | May 19 | Graham County, Kans | ..... | 100 | 163 seeds of black locust. |
| | | 1892. | | | | |
| 3872 | ♂ | Aug. 23 | Washburn, Tex.. .... | ..... | 100 | Seeds of prickly pear (*Opuntia r. cymochila*). |
| | ♂ | Aug. 31 | Kiowa, Kans..... | ..... | 100 | Wild peas (*Hosackia purshiana*). |

## MEXICAN SPERMOPHILE.

### Spermophilus mexicanus (Licht.).

[Map 3, B.]

*Description.*—This species resembles *Spermophilus tridecemlineatus.* The ears project but slightly from head, and the tail is long and quite bushy. The sides and legs are buff; the belly and throat whitish; the back light brown with usually nine or eleven rows of white or buff spots, no solid buff stripes, but the spots are arranged in rows extending from head to tail along middle of back and become shorter laterally; the dorsal stripe is indistinct.*

The following measurements are those of an average-sized specimen selected from twelve adults: Total length from nose to tip of tail vertebræ, 308 millimeters (12¼ inches); length of tail vertebræ, 128 millimeters (5 inches); length of hind foot from point of heel to point of longest claw, 42 millimeters (1⅝ inches).

*Range.*—This Mexican species enters the United States only in southwestern Texas and southern New Mexico, extending thence over the table-land of Mexico to Zapotlan, Jalisco, and as far south as the Valley of Mexico and Orizaba.

The area shown on the map gives an idea of only about half of its distribution. It is known to occur in at least nine states of Mexico—Coahuila, Guadalajara, Guanajuato, Hidalgo, Mexico, Nuevo Leon, Puebla, Tamaulipas, and Vera Cruz. Its range apparently extends across the table-land of Mexico from Mt. Orizaba nearly to the volcano of Colima, and from the Valley of Mexico to the mouth of the Rio Grande, and thence northwestward to El Paso. As yet only a few outlying points have been determined and much data is needed to determine accurately the

* This spermophile is distinguished from the two species of United States spermophiles, which it most nearly resembles and with which it comes in contact, as follows: From *S. tridecemlineatus* by the absence of solid lines of buff alternating with the rows of spots, and from *S. spilosoma* by the spots being arranged in rows instead of scattered irregularly over the back.

eastern and western limits of its range. In the United States its range covers the southwestern third of the State of Texas, extending as far north as Mason, Stanton and Colorado, while it follows up the Pecos Valley as far as Eddy, New Mexico.

*Habits.*—I have met with it in but one locality, Del Rio, Tex., where it was living on low, brushy land and among mesquites. At that season (February), it seemed to keep very quiet as though in a state of semi-hibernation, and was rarely seen. I found a hole with the entrance carefully packed full of dirt, evidently filled from within. A careful search failed to discover any other opening to the burrow, so I removed the dirt and set a small steel trap in the hole a few inches from the entrance. The next day the trap contained a spermophile caught in such manner as to indicate that the animal had been taken while attempting to leave its hole. It was dead, with its head in the trap and the body back in the hole. I was much puzzled at the time that a spermophile should close the entrance to its burrow after the manner of the pocket gophers, kangaroo rats, and pocket mice, but Mr. Wm. Lloyd has since mentioned the same habit in writing of the species at Mier, Mexico. He says: "They are common about here, and make numerous burrows in the little hillocks at the foot of shrubbery. The main hole can always be distinguished, as it is invariably covered up. Their burrows extend for a considerable distance, about 10 inches or a foot, under ground. One that gave way beneath my feet I opened up for 2 yards each way and there was no hole near. I hoped that I was on the track of a mole, but a trap in each section of the tunnel gave me the occupant, a spermophile."

At another locality Mr. Lloyd states that their holes were not covered, but it seems that this species does sometimes at least close the entrance to their burrows, contrary to the traditions of spermophiles in general. The same habit has been reported in the case of Franklin's Spermophile, where introduced in New Jersey, though I never knew of their practicing it in their native haunts.

I have never heard the voice of *Spermophilus mexicanus*, nor can I find any reference to it. Their habits seem to be little known. Mr. B. H. Dutcher found these spermophiles at Stanton and Colorado, Tex., and at Eddy, N. Mex. He says: "It is somewhat difficult to observe the habits of this species while on foot, as it is shy, and is hidden by the grass from an observer. Those that I saw running seemed to move both fore feet at once, and both hind feet at once, thus moving in what might technically be called a gallop. Considerable speed is attained, and their motions are in no way sluggish as are those of the prairie dog. I saw none at rest, but the family with whom I lived at Colorado had formerly had one as a pet, and they frequently described to me how this individual used to stand on his hind feet. From this, and also from analogy, I infer that an upright position is a common one in nature."

"Both at Colorado and at Stanton this species was trapped with greatest success at the roots of mesquite trees, where the spermophiles seem to prefer to dig their burrows. The holes were not uniformly regular in outline, but invariably seemed to descend at an angle and not vertically.

"At Eddy, N. Mex., the species was fairly common, inhabiting the stony or shingly land. I did not find it at all in the sand, except at the edges, where the sand met the shingle. On the lower staked plain, or on what may be termed the 'large-mesquite plain,' they did not seem to inhabit the sandy land or 'shinn'ry,' but rather confined themselves to the hard red soil and mesquite groves."

Mr. E. W. Nelson has observed this species in Mexico, and says: "It is found about the borders of the Valley of Mexico [near Tlalpam], but is restricted in its distribution. It is only found in loose and rather sandy soil, in fields and along the banks of arroyos, near the border of the valley bottom. * * * It is not uncommon in the grain fields about Irolo, Hidalgo. One was found sunning itself early one morning beside a clod of earth in a field. It remained so quiet at our approach that my assistant and myself stopped within eight or ten feet of it and discussed the question whether it might not have one of our small traps on its feet. To make sure, I took a small piece of hard clay and approached within almost arm's length to strike it, when it darted off across the field with all possible speed, and was only secured by a quick shot. As a rule, these animals are very shy, and make for their holes long before one gets within gunshot. They are so vigilant and quick to take alarm that but few are seen, even when comparatively common.

## FRANKLIN'S SPERMOPHILE.

**Spermophilus franklini** (Sabine).

[Plate II—Map 2.]

*Description.*—This spermophile has somewhat the appearamce of a small gray squirrel, but has ears less than half as long and a smaller tail. The hair is coarse and harsh. In color, it is gray, lighter on the belly, becoming whitish on the throat; the back is suffused with tawny or yellowish brown, and marked with fine wavy cross lines of black; the head and tail are usually clear gray.

The measurements of an average-sized specimen selected from ten adults are as follows: Total length, from end of nose to end of tail vertebræ, 378 millimeters (14⅞ inches); length of tail from angle with back to tip of vertebræ, 139 millimeters (5½ inches). Length of hind foot from point of heel to tip of longest claw, 52 millimeters (2 inches).

Franklin's Spermophile is locally known under the names of Gray Ground Squirrel, Gray Gopher, Scrub Gropher, Prairie Squirrel, and Gray-cheeked Spermophile. Any one of these is distinctive enough where the animal is found, but beyond its range the terms Gray Ground Squirrel and Gray Gopher apply just as well to nearly a half a dozen species of somewhat similar animals found in the Rocky Mountain and

Trautmann, Bailey & Blampey N.Y.

FRANKLIN'S SPERMOPHILE, SPERMOPHILUS FRANKLINII (Sabine.)

Pacific coast regions.* The name Prairie Squirrel, while serving to distinguish it from the arboreal squirrels, does not distinguish it from the other species of prairie squirrels. Gopher, both from general use and origin of the name, should be restricted to the pocket gophers (*Geomys* and *Thomomys*). Let us drop all but Franklin's Spermophile, which can be confounded with the name of no other animal.

When numerous it is an exceedingly troublesome animal, destroying much grain both by digging up the seed and by cutting and tangling down the ripe grain, and occasionally feasting on small chickens from the poultry yard. At the same time, it eats vast numbers of insects of the species particularly injurious to crops, and in this way the good it accomplishes may exceed the loss sustained from its depredations. An examination of the contents of twenty-nine stomachs shows something of the character of the food selected and is decidedly favorable evidence of the animal's usefulness. If by any means its depredations can be prevented without destroying the animals it becomes the most useful protector of farm products. Various means for preventing their attacks on sprouting grain have been employed with some degree of success. Others more effectual may yet be devised.

*Range.*—The species was first described by Sabine in 1822 from specimens collected at Carlton House on the Saskatchewan River in Manitoba. From this point it ranges south over the Red River and Mississippi valleys to central Missouri and southern Kansas, inhabiting the prairie region from its eastern edge along the line of heavy timber westward to central Kansas and the Dakotas. Its eastern limit corresponds closely with that of the Striped Spermophile, but does not reach Michigan, nor extend as far south as the range of that species. The boundary of its distribution in Minnesota may be indicated by a line drawn from the northwest corner of the State to St. Paul. In Wisconsin the northernmost records come from Plover and Ripon, where it is rare; only two records have been received from Indiana—Kentland and Earl Park—both near the western boundary of the State. Its southern limit is indicated by Bement and O'Fallon Depot, Ill.; Sedalia, Mo., where it was said to occur formerly; and Erie and Kellogg, in southeastern Kansas.

Franklin's Spermophile ranges west to Belvidere and Kearney in southern Nebraska, and in the Dakotas is not known to pass west of the Missouri River, except at Willow Creek a few miles west of Pierre, S. Dak. Its western limit corresponds closely with the eastern limit of the prairie dog (*Cynomys ludovicianus*), the one occupying the moist and fertile eastern prairies, the other the more arid western plains.

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*Within its range (as shown on the map), there is no animal closely resembling it or that need be mistaken for it by even a careless observer. The Rock Squirrel (*Spermophilus grammurus*) of the Rocky Mountains and foothills has somewhat the same general appearance, but when full grown is much larger, with longer tail and ears.

At Elk River, Minn., where I first made their acquaintance in the spring of 1872, they were rather scarce, though on a farm with the best of opportunities for observing them, usually not more than six or eight were seen during a summer for the succeeding fourteen years of my residence in this place. As they were not sufficiently common to do much damage, they were rarely killed, and their numbers seemed never to change appreciably. This locality is at the extreme eastern limit of their range in that latitude. A little further west they are much more common, and seem to reach the maximum abundance along the valleys of Minnesota and Red rivers.

*Introduction into New Jersey.*—A widely isolated colony of these spermophiles exists in eastern New Jersey, in the region about Tuckerton, where a single pair, brought from Illinois, escaped from their cage in 1867. Concerning the origin of this colony, Dr. J. A. Allen has written briefly as follows:

"I learned of its introduction there through Mr. Samuel Jillson, who first wrote me about it some three or four years since. Writing him recently for further information respecting the date and manner of its introduction, as well as for information respecting its present numbers and the area of its range, he has kindly replied as follows, under date of 'Tuckerton, New Jersey, May 6, 1877':—'The date of its introduction is May, 1867, when a single pair was brought here by Mr. Sylvester Mathis, from Illinois. This pair soon gnawed out of their cage and escaped. This was in the village of Tuckerton. They are now found in Minahawken, 9 miles north of Tuckerton, and also 4 miles south of Tuckerton, and very likely farther. They are very common on all the farms about here, 3 miles from the village' [of Tuckerton]." (Monographs N. Am. Rodentia, 1877, p. 883.)

In June last year Mr. E. A. Preble, of the Division of Ornithology and Mammalogy, visited Tuckerton, N. J., for the express purpose of ascertaining whether this introduced colony was increasing and whether their depredations were of a serious nature. In his report he says: "They are known to the inhabitants as the 'Prairie Squirrel' in contradistinction from the gray timber squirrel native to the region. Instead of increasing in the vicinity of Tuckerton their numbers have diminished of late years from the constant war waged against them by men, boys, and dogs. Still their range is steadily widening, and they are now common over much of the southern portion of the State. They have spread westward almost across the state to Auburn, Salem County, near the Delaware River, and northward at least as far as Red Lion, in Burlington County. The sandy uplands seem to furnish a congenial soil in which to make their burrows, which are usually placed in brushy fence corners along fields and roads or occasionally out in open fields. True to their native instincts they do not enter the more thickly timbered regions, but keep to the naturally open land or cleared fields, pastures, and roadsides.

"They are destructive to a number of crops, but particularly to corn, which they dig up after it is first planted in the spring. When the animals are numerous this frequently necessitates replanting and constant watching of the corn by the farmer who wishes to secure a crop. They also destroy a considerable quantity of corn as it stands in the shock in the fall and are said to eat peas and various grains. It is claimed that they frequently kill young chickens and ducks, though I was unable to procure definite data on the subject. It is probable that a few such cases have been freely reported and are less common than is generally believed."

*Habits.*—Franklin's Spermophile is characteristic of prairies and open country, is never found in heavy timber, and does not climb trees. The places usually selected for their holes are among tall grass, weeds, and scattered brush. Often they are found living along the edge of timber that adjoins the prairie or in small groves. At Devils Lake, N. Dak., they were most common in the straggling groves of small trees a little back from the lake, and many of their burrows were placed under logs and stumps or between the roots of trees.

They frequently take up their abode near buildings, especially about barns and sheds, and in many cases prove troublesome neighbors. In the summer of 1887 I found them numerous at Browns Valley, on the western boundary of Minnesota, especially among the buildings along the edge of town. Some had holes under houses which were occupied, and I saw one sitting up within 15 feet of an open door. A lot of manure had been hauled out of town and piled on some waste land beyond the city limits, and quite a colony had collected around it. They were digging in the manure and seemed to find some kind of food in it.

In but few places are they as common as the smaller Striped Spermophile (*S. tridecemlineatus*), though the two species range together over a wide area. Their habits are quite similar and it is often difficult to distinguish the voice of one from that of the other. The note of Franklin's Spermophile is somewhat heavier and has a slightly different ring, but it is the same shrill, rapid chipper or trill. It is sharp and ringing and may be heard for a considerable distance.

Like all spermophiles they are frequently seen standing up on their hind feet, straight and motionless. After watching several of them quietly feeding for a time, I have attracted their attention by a slight noise in order to see them rise quickly to an erect position. They seem to stand as firmly on two feet as a person. Usually they run low and go scudding through the grass, but if badly frightened will take long high leaps, precisely like a gray squirrel.

*Appearance in spring.*—In autumn Franklin's Spermophiles become excessively fat and with the first cold weather disappear into their holes and do not come out again until the following spring. The date of their reappearance depends on the season as well as on the latitude of the place, but in the States along our northern boundary it is usually

in the latter part of April. In North Dakota Mr. Evelon Brown reports them as first seen at Bathgate, in the spring of 1889, on April 3, and in 1890 on April 21. In Minnesota Dr. Thomas S. Roberts reports their first appearance at Minneapolis on April 30, 1877, and April 23, 1878, while Mr. Plummer L. Ong noted their first appearance at Hennepin, Putnam County, Ill., in the second week of April in 1884. Like other hibernating animals, they usually come out 'spring poor.' If the stores of grain are not eaten during winter, they probably are during spring when other food is scarce.

The young are evidently born some time in May or June, as by the 1st of August half-grown animals are out of the holes hunting food for themselves. One female examined contained six embryos, which is probably the usual number of young in a litter.

Why this spermophile should not be considered fit for food is a mystery, of which the only explanation seems to be an unreasonable and almost universal prejudice against eating burrowing animals. I can not speak from experience, but others who have eaten them say that they are excellent, and other species of the same genus that I have eaten are equal to the best of the tree squirrels. Anyone who will study their habits carefully will find no reason why they should not be a staple article of food. The holes in which they live are as clean as the home of any squirrel; new holes are dug each year or the old ones extended into fresh soil. New nests of grass and soft plants are provided in autumn, and no dirt of any kind is allowed to remain in the holes. Nor is there anything in their food habits to render them objectionable.

*Injury to crops.*—The following extracts from letters received by the Division of Ornithology and Mammalogy contain interesting notes on the habits of this species and the damage caused by its depredations:

According to Mr. Lawrence Bruner of Lincoln, Nebr., "Franklin's Spermophile is quite common in some parts and rare in others. It is a pest to farmers. It is carnivorous, at least when in captivity, as I can testify from experience with one I had caged during the greater part of one summer. After having been in the cage for about a month I turned in a mouse, one day, in order to have a 'happy family' in my menagerie. Imagine my horror, then, to see Mr. Squirrel pounce upon the mouse, kill and eat it in such a manner as to indicate that it was not the first mouse thus eaten. The bones were held in the fore feet and stripped clean, after which they were dropped. The time occupied for the entire task of killing and eating the mouse was not more than five minutes."

Prof. L. L. Dyche, of Lawrence, Kans., gives the following account of the species under date of October 12, 1888: "Not much damage is done by this species (at least, not much thus far reported), except in certain localities, and mostly where fields are inclosed by stone walls. The squirrels dig up the corn (and sometimes other seeds) soon after it is planted in the spring and in the fall do some damage by

burrowing under corn shocks. They eat some corn and usually carry considerable down in their holes in the ground. On my father's farm, 36 miles west of here, at Auburn, Shawnee County, Kans., they were very common several years ago. They would dig up the corn almost as fast as it was planted for a distance of a few rods in from the stone walls wherever the latter inclosed the fields. On an average I think there could not have been less than one squirrel for each rod of fence. Apparently there was one for each few feet. We killed many of them with guns and tried to poison them, with apparently very little success. By scattering shelled corn along the fences for the squirrels to feed upon while the planted corn was coming up most of the difficulty was obviated. A wary old female cat, which had taken up her quarters in a barn in one of the fields, caught many of the squirrels, and was accustomed to carry them to her kittens when the latter were large enough to feed upon such things. The offspring of this cat, when they were full grown, also preyed upon the squirrels. In the course of a few years these cats, over a dozen in number, almost exterminated the squirrels. They would sit on the stone walls and pounce upon the squirrels when the latter came out from their hiding places. These same cats also caught many rabbits. I do not know of any other instance where cats caught the large ground squirrels to any considerable extent."

From La Moure, N. Dak., Mr. C. B. Struble writes: Franklin's Spermophile is most destructive in dry seasons, when it comes in from the surrounding prairie. The burrows are not confined to the edges of fields, but are found all over them. Summer fallowing removes them by starving them out. They are very destructive to gardens, especially to peas and cabbage; some slight damage is also done by digging up seed in the spring. Poison is the only effective remedy against them. County commissioners distribute poison free of expense to all farmers applying for it."

At Ripon, Fond du Lac County, Wis., where this species is rare, Prof. W. W. Cooke considers that it does no harm. He says: "At Ripon the Striped Gopher does damage, but the Gray Gopher does none. The Gray Gopher is very scarce there. I have not seen a dozen specimens in more than as many years' residence in that vicinity, whereas at White Earth, Minn., they were abundant and did an immense amount of damage."

We are informed by Prof. C. B. Waldron, arboriculturist of the North Dakota Agricultural College and Experiment Station, that in eastern North Dakota, where Franklin's Spermophile was formerly abundant, it is now being driven out by Richardson's Spermophile, which is on the increase in this region.

Robert Kennicott says of this species: "They fed upon June grass, clover, timothy, and the broad-leaved plantain, and seemed particu-

larly fond of the leaves of the common mustard, of which some plants grew near their burrows. Other specimens examined in summer had their stomachs filled with grass alone. In eating they sat upright on the tarsi and used their fore feet as hands to draw the leaves to their mouths, though their paws were used thus with less facility than those of the true squirrels. Though both the vegetable and flower garden were situated within 5 rods of their burrows I do not remember that they were observed to injure either. A number of young chickens disappearing, however, and the eggs being eaten in several hens' nests near the burrows of the spermophiles, suspicion rested upon them—probably unjustly—and a war of extermination was commenced. Several were shot, while others were killed with clubs, whereupon the survivors left in a body as suddenly as they had come and were never seen again, nor could they be found upon any part of the farm. I have known this spermophile to take refuge in a hollow tree, crowding up the hole like a gray rabbit. Mr. F. C. Sherman, of Chicago, informs me that he twice saw one, when pursued, climb 5 or 6 feet up the trellis work and vines at the side of a house.

"The burrow of this species is usually deeper than that of the Striped Spermophile, but otherwise similar to it. The young I have not observed, but Mr. George S. Parker, of Pecatonica, Ill., writes me that he once saw five and at another time seven young in a nest. They appear to go into winter quarters in the fall and reappear in the spring at about the same time as the Striped Spermophile. They have been found hibernating under piles of rails and in corn shocks, and I am informed of two instances in which one has been found torpid in a haystack, where he had formed a burrow in the hay. I have never heard of its hibernating in such situations. A caged specimen of Franklin's Spermophile, kept by Prof. Baird, of the Smithsonian Institution, was active all winter; and Dr. A. M. D. Hughes, of Payson, Ill., informs me that he found one in a burrow under a corn shock, active in mild weather late in November.

"This species is carnivorous, though apparently less so than the Striped Spermophile. A specimen kept by Prof. Baird was decidedly carnivorous, but one observed by Dr. Hoy did not eat mice, though it killed them when placed in the cage. Its food is generally similar to that of the Striped Spermophile, stores being also found in its burrow. It gnaws hard substances more than the Striped Spermophile, and, while the latter will not gnaw out of a box, this readily does so. Caged specimens cut open hazelnuts also.

"This squirrel injures the farmer by taking up newly planted corn, as does the Striped Spermophile. Being far less abundant than the other, however, it is usually less complained of on newly broken land; but it is sometimes the more injurious of the two on old farms, where it burrows in cultivated fields more willingly than the other. It frequently burrows during summer in grain fields, where it eats the green plants,

and afterwards the heads of grain as the kernels fill; and in this manner, and by throwing down the standing grain, spoils it for some distance around the burrow. Having a great predilection for burrowing in ditch-banks, and in underdrains filled with brush, it often does serious injury in this way.

"This species may be destroyed in the same manner as the preceding, though they are not so easily drowned out of their holes, especially when they are in a bank or drain. They appear to leave their burrows with less caution, and for a greater distance, than the others; and, being also less active, they are sometimes chased and killed with a stick. They are probably more liable to the attacks of rapacious animals than the others. I have known domestic cats to catch them when full grown.

"It is possible that the Striped Spermophile drives off this species, as the two are not found occupying the same field." (Report Commissioner of Patents for 1856, pp. 80–81.)

## FOOD.

A large part of the food of Franklin's Spermophile consists of grain and various seeds. Corn, wheat, oats, and rye are favorite foods, and where the spermophiles are numerous farmers often sustain considerable loss from their depredations, especially from the seed which they dig up after it is planted. The amount of ripe grain eaten and carried to their holes and stored for winter is of less consequence. In fields of small grain, as wheat, barley, and oats, they do not usually cut down the stalks, as do the smaller spermophiles, to get at the grain, but bend them over. In this way they tangle and trample down much more than they eat or carry away. The amount of damage depends on their abundance. Where most numerous it is quite serious. Their fare is extensive and by no means limited to grain or vegetable matter, as shown by the contents of the stomachs examined. Grasshoppers, crickets, beetles, and caterpillers are standard articles of diet, but ants and various other insects are also eaten.

*Table showing food found in 29 stomachs of Franklin's Spermophile (Spermophilus franklini).*

| ANIMAL. | VEGETABLE. |
|---|---|
| Beetles, large and small species (*Coleoptera*). | Grain (wheat and oats). |
| Larvæ of beetles (*Coleoptera*). | Seeds of basswood (*Tilia*). |
| Caterpillars (larvæ of *Lepidoptera*). | Strawberries. |
| Grasshoppers and crickets (*Orthoptera*). | *Solanum* berries. |
| Ants. | Herbage, stems and leaves of plants, among which only an *Equisetum* could be recognized. |
| Eggs of insects. | Roots. |
| Chrysalis. | |
| Feathers of small bird. | |
| Spermophile hair, probably their own. | |

At Pembina, N. Dak., I found several young mice (*Sitomys michiganensis*) in the stomach of one of these spermophiles and at Ortonville, Minn., I shot one in the act of eating a freshly killed wood phœbe (*Contopus virens*). It had evidently just caught the bird, though it is difficult to understand how. Speaking of the omnivorous habits of the species Prof. C. L. Herrick says: "During the summer it feeds upon wild fruits, such as strawberries, but has well-marked carnivorous propensities. During a few days' encampment on Lake Traverse, several of these animals became so domestic as to partake freely of fish from our table so long as no suspiciously hasty motions were executed by the human participants." (Mammals of Minn., 1893, p. 167.)

Mr. David H. Henman, of Willows, N. Dak., reports that Franklin's Spermophile kills small chickens, and similar complaints have been made of the small colony introduced into New Jersey. "Mr. Jillson writes under date of May 18, 1885: 'They are not numerous enough yet to do a great deal of damage to crops, but if a pair takes up its abode near small chickens or turkeys they soon thin them out'" (Herrick, *loc. cit.*, p. 168). At Browns Valley, Minn., they were said to have killed five chickens that were feathered out and as large as quails. The woman who told me about it saw a spermophile catch and kill one of the chickens. Others have reported cases where they were strongly suspected of killing young chickens, and, from their decidedly carnivorous tastes, there is no reason to doubt that the blame was correctly placed.

For the purpose of ascertaining the food of this species with greater precision than is possible by general observations, twenty-nine stomachs were collected, and the contents examined in the laboratory. In most cases the stomach contents were well masticated and so thoroughly mixed that no system for accurately measuring the proportion of the different substances could be applied. Small seeds were often found unbroken, and wheat, oats, barley, and other large seeds could usually be recognized by the shells and harder parts that remained. Grasshoppers and crickets were easily recognized by the legs, wings, jaws, and other tough parts, while the skins of caterpillars often remained entire and served to show the order, if not the genus, to which they belonged. A great many small insects were so finely chewed that nothing remained to show what they were.

*Summary of the contents of twenty-nine stomachs.*—Animal matter, 30.3 per cent.; vegetable, 68.5; matter not positively determined as to whether animal or vegetable, 1.2.

*Table showing contents of 29 stomachs of Franklin's Spermophile (Spermophilus franklini).*

| Cat. No. | Sex. | Date | Locality. | Percentage of animal matter. | Percentage of vegetable matter. | Contents. |
|---|---|---|---|---|---|---|
| | | 1887 | | | | |
| 11 | ♂ | May 17 | Heron Lake, Minn.... | 10 | 90 | A beetle; caterpillars; grain; herbage. |
| 12 | ♀ | May 18 | .....do..... | 1 | 99 | Leg of beetle; seeds; herbage. |
| 23 | ♀ | May 27 | Flandreau, S. Dak .... | 50 | 50 | One beetle; many caterpillars; seeds; herbage. |
| 34 | ♂ | June 6 | Ortonville, Minn..... | 3 | 97 | A few caterpillars and beetles; seeds. |
| 35 | ♀ | June 6 | .....do..... | 25 | 75 | 20 larvæ; grasshopper's leg; small insects; oats; basswood seeds; herbage. |
| 36 | ♂ | June 6 | .....do..... | 50 | 50 | Larvæ; fragments of insects; basswood seeds; vegetable matter. |
| 37 | ♂ | June 6 | .....do..... | 20 | 80 | 26 coleopterous larvæ; seeds; herbage; piece of *Equisetum* stem. |
| 39 | ♂ | June 7 | .....do..... | 50 | 50 | Coleopterous larvæ; cricket; small insects; spermophile hair; vegetable matter. |
| 40 | ♀ | June 7 | .....do..... | 50 | 50 | Over 20 coleopterous larvæ; remains of vegetable matter. |
| 41 | ♂ | June 7 | .....do..... | 50 | 50 | Coleopterous larvæ; cricket; beetle; smaller insects; vegetable matter. |
| 42 | ♂ | June 7 | .....do..... | 50 | 50 | Beetles and caterpillars; hulls and fibrous vegetable matter. |
| 45 | ♂ | June 8 | .....do..... | 45 | 55 | A caterpillar's skin; bit of vegetable fiber; black indeterminate matter. |
| 46 | ♂ | June 8 | .....do..... | 10 | 90 | Caterpillar remains; hulls of oats and perhaps other grains; hulls of basswood seeds; chewed vegetable matter. |
| 47 | ♂ | June 8 | .....do..... | 25 | 75 | Over a dozen caterpillars; seed pulp; herbage. |
| 61 | ♂ | June 11 | .....do..... | 5 | 95 | Beetles; lepidopterous larvæ; feathers; some of the animal's hair; chewed vegetable matter; a few grain hulls; basswood seeds. |
| 72 | ♀ | June 18 | Fort Sisseton, S. Dak . | 90 | 10 | Mostly insects; larvæ; ants; a little vegetable matter. |
| 74 | ♂ | June 20 | .....do..... | 25 | 75 | Insects; grain; herbage. |
| 75 | ♂ | June 22 | Browns Valley, Minn. | 5 | 95 | A few bits of insects; strawberry seeds; herbage; grain. |
| 90 | ♀ | June 28 | .....do..... | 50 | 50 | Mostly grasshoppers and roots. |
| 128 | ♀ | July 8 | .....do..... | 50 | 50 | Large white grubs (larvæ of beetles), vegetable matter. |
| 134 | ♂ | July 12 | Harwood, N. Dak..... | 10 | 90 | Insects and vegetable matter; strawberry seeds. |
| 135 | ♀ | July 12 | .....do..... | 25 | 75 | Insects; finely chewed herbage and seeds; strawberry seed. |
| 138 | ♀ | July 18 | Grand Forks, N. Dak . | 50 | 50 | Insects; one larva; shells of beetles; oats. |
| 146 | ♂ | July 19 | .....do..... | 5 | 95 | A few pieces of insects; chewed grain |
| 147 | ♂ | July 22 | Pembina, N. Dak ..... | 15 | 85 | Small insects, hairs of *Spermophilus 13-lineatus;* wheat; seeds of *Chenopodium*. |
| 148 | ♂ | July 22 | .....do..... | 20 | 80 | Crickets; beetles; leaves; roots; grain; indeterminate matter. |
| 168 | ♂ | July 26 | .....do..... | 75 | ..... | Eggs of some insect; indeterminate matter. |
| 209 | ♂ | Aug. 10 | Devils Lake, N. Dak.. | 1 | 90 | Feathers; a few hairs; oats; skins and seeds of *Solanum* berries. |
| 210 | ♂ | Aug. 10 | .....do..... | 15 | 85 | Caterpillar; cocoon and chrysalis; 1 feather; hairs; roots and wheat. |

## KENNICOTT'S SPERMOPHILE.

### Spermophilus spilosoma obsoletus Kennicott.

[Map 3, A.]

*Description.*—This is an obscurely marked, dull-colored, little spermophile with ears hardly perceptible and short, slender tail. The lower parts are white or soiled whitish, the sides yellowish white. The back is ashy gray, usually covered irregularly with obscure spots of whitish, bordered posteriorly by black. It is unlike any other species near its known range, but resembles quite closely some of the forms of *Spermophilus spilosoma* in western Texas, New Mexico, and Arizona.

The following measurements are those of an average sized specimen selected from fifteen adults: Total length from end of nose to end of tail vertebræ, 222 millimeters (8¾ inches); length of tail from base to tip of vertebræ, 62 millimeters (2½ inches); hind foot, heel to tip of claw, 32 millimeters (1⅓ inches).

This species was first described in 1863 by Robert Kennicott, from specimens taken at O'Fallon's Bluff, on the Platte River, Nebr. Dr. Allen calls it Kennicott's Spermophile, but so far as I have been able to learn, no common name has been applied to it by people living within its range. It is sometimes spoken of as the little Spotted Ground Squirrel in contradistinction to the Striped Prairie Squirrel (*Spermophilus tridecemlineatus*), as both species are found in the same localities.

So far as our present knowledge goes, its range is limited to Nebraska, eastern Wyoming, and South Dakota south of the Black Hills. In Nebraska it has been taken 50 miles west of Fort Kearney, at Valentine on the Niobrara River, and has been reported at Fort Robinson. It has also been found on the South Fork of White River, S. Dak.; at Fort Laramie, Wyo.; and and at Sterling, Colo. The sandhill region of western Nebraska seems to be the center of its abundance. I have met with them at several points in Cherry County, where they seem to be more common than the Striped Spermophile and of nearly similar habits.

They were so shy and quiet and their colors and markings blend so perfectly with their surroundings that they are rarely seen, although not difficult to catch in traps. They usually choose the light sandy soil in which to make their burrows, a habit possessed in common by the kangaroo rat (*Perodipus ordii*), which occurs in this locality and at the unoccupied holes of which they are frequently caught. The habit of the kangaroo rat of digging many more holes than it can occupy or has any apparent use for seems to be appreciated by this spermophile as well as by a number of other species of small rodents, which appropriate them instead of digging holes for themselves, although Kennicott's Spermophile does construct a burrow for itself.

We may infer that the young are born and cared for in the burrows until old enough to be safely trusted above ground. They seem to be brought forth later than the young of most spermophiles. On June 20, 1888, I caught two females, each containing eight young that would not have been born for some time. In the case of each of these

Trautmann, Bailey & Blampey, N.Y.

RICHARDSON'S SPERMOPHILE, SPERMOPHILUS RICHARDSONII (Sabine.)

females the teats numbered ten, indicating that larger litters of young may sometimes be produced.

I have heard the voice of this spermophile on but one occasion, when I mistook it first for the voice of the Striped Spermophile, but after catching the animal it occurred to me that the voice was higher and more like that of the Sonoran Spermophile (*Spermophilus spilosoma*), to which this species is most nearly related. However, there is so little difference between the voices of *S. tridecemlineatus* and *S. spilosoma* that the one might be mistaken for the other unless careful attention be given them by one familiar with both.

*Food.*—Of the food habits of this species we know very little. The stomach of one specimen that I examined at Kennedy, Nebr., April 24, 1888, contained seeds and the remains of some young mice. The stomach of another taken on the same day contained seeds and insects. Other stomachs examined contained seeds, green herbage, and insects. From these few examples it would seem that their food is nearly as varied and of much the same nature as that of the Striped Spermophile.

From an economic point of view this species is not of great importance from the fact that it is not numerous in farming districts. Most of the country inhabited by it is grazing land and but thinly settled. The most serious complaint against it is that it digs up the tree seeds planted on timber claims on the Nebraska prairies, but this may be obviated by proper care. Those living in the neighborhood of fields or where trees are planted may be easily killed by any of the methods described on pp. 25–27. When once killed off near the fields, others will not spread over the ground for some time, usually not until the crop is beyond their reach.

## RICHARDSON'S SPERMOPHILE.

**Spermophilus richardsoni** (Sabine).

[Plate III—Map 4.]

*Description.*—Richardson's Spermophile, with its short legs, tail, and ears, strongly resembles a small prairie dog in general form and color. It has no distinct markings or pattern of coloration; the outer coat is composed of longer hairs covering the fur; the inner fur is soft and silky, even in August, becoming thick and beautiful in autumn. The lower parts are plain buffy, becoming brighter on the shoulders and sides of neck; the top of the head, cheeks, and back are grayish buffy from a mixture of black hairs and the darker under-fur; the tail is plain buff below, washed on the upper surface with black, and bordered by lighter buff. No dark lines are visible in the colors of the tail, but the back is faintly marked with fine dots or wavy crosslines.*

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* The only animal with which it can be confounded is *S. richardsoni elegans*, a southern subspecies, somewhat darker colored and less buffy. Specimens from North Dakota and Manitoba are the true *richardsoni*, while those from Wyoming and Idaho are referred to *elegans*. At some future time it may be possible to draw an arbitrary line across Montana separating the two forms.

The following measurements of a specimen selected from eleven adults represent the average size: Total length, from end of nose to end of tail vertebræ, 311 millimeters (12¼ inches); length of tail vertebræ from angle at base to tip, 82 millimeters (3¼ inches); length of hind foot, from heel to tip of longest claw, 46 millimeters (2 inches).

*Range.*—Like Franklin's Spermophile this species was first described by Sabine from specimens collected at Carlton House on the Saskatchewan River more than 70 years ago, and this locality is still the northernmost known point of its distribution. Fortunately it ranges over a comparatively small area in the United States, being restricted to North Dakota and Montana; but in Canada it covers the great plains of Assiniboia and Saskatchewan. The eastern limit of its range may be marked by a line passing in a southeasterly direction from Carlton House through Petrel and Carberry, Manitoba, to the United States boundary, some distance east of Turtle Mountain. In the Red River Valley it occurs from Mayville south to Harlem, N. Dak. Aberdeen, S. Dak., in the James River Valley, is the southernmost point at which it is known. In North Dakota and Montana we have no records of its occurrence south of the Missouri River though the species is more or less common at Bismarck, N. Dak., and at the mouth of Milk River and Fort Benton, Mont. In the latter State it is found as far west as the Rocky Mountains, at Chief Mountain, Birch Creek, and Choteau.

Its southern subspecies, the Wyoming Spermophile (*Spermophilus r. elegans*), extends over the sage plains of Wyoming from Cheyenne and the Laramie Mountains westward to Idaho. It is also found in northern Utah and at Fish Creek in the extreme northern part of Colorado. In Idaho it is chiefly a harmless occupant of uncultivated lands; but in Wyoming it does immense damage to crops.* Richardson's Spermophile is extremely abundant about the little town of Bottineau, where it is found only on high prairies, and seems to avoid brushy or low weedy land. It is generally distributed over the prairies, but in some places has collected about grain fields and does considerable damage by eating, carrying away, and destroying grain.

*Habits.*—Like every species of spermophile that I have observed, these animals are strictly diurnal. From sunrise till about 9 o'clock they are very active, and may be seen running or sitting up all over the prairies, even at the very edges of towns. After 9 a. m. they retire to their burrows and are rarely seen during the rest of the day; but as

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* Prof. F. J. Niswander, entomologist of the Wyoming Experiment Station, gives the following account of its depredations: "On the Laramie experiment farm the acre plat, containing several varieties of barley, was so badly injured that, in some instances, the yield was less than the amount of seed sown. The plats containing the different varieties of oats were also badly damaged. Our acre plat was not harvested owing to the ravages of these squirrels. Of several varieties harvested only enough seed was obtained to repeat the experiment during the present season.

"Mr. J. S. Meyer, superintendent of the experiment farm at Lander, Wyoming, says: 'We are bothered a great deal with gophers; they are death on carrots and alfalfa.'" (Wyoming Experiment Station Bull. No. 12, April, 1893, p. 25.)

these observations were made late in August, it is probable that the animals were then nearly ready to hibernate, and consequently spent more time sleeping than earlier in the summer.*

They are the least suspicious and most inquisitive of all the spermophiles I have known. They would stand watching me until I approached within a few rods, and if finally frightened into their holes would soon reappear to watch me from their doorways. Probably as they become better acquainted with man and his gopher-destroying inventions, they will learn to be more suspicious and less inquisitive. When running, they flop their short tails up and down like a woodchuck or prairie dog, and when sitting up they keep shaking them as they chipper, just as prairie dogs do.

Their holes are large, with a little mound of earth like a pocket gopher's hill in front of each. They seem to be quite deep and to descend with a steep pitch for the first few feet.

Of thirteen specimens taken near Bottineau, N. Dak., twelve were males. All were very fat, and were in good condition to hibernate as soon as the ground began to freeze. It was too late in the season to learn anything of their breeding habits, but Mr. Ernest E. Thompson, in his list of the mammals of Manitoba, says: "My notes on the breeding season are very brief and inconclusive, but such as they are, they indicate that the young are born about the middle of May. They number sometimes as high as eleven. About the end of June they are half-grown, and begin to show themselves outside of their burrows." He also states that they appear above ground in spring before the snow is gone, which is some time before the appearance of the Striped Spermophile, and that they do not hibernate in autumn till about a fortnight later than that species.

The spermophiles that do not live near grain fields feed largely upon green vegetation, grass, and various plants. Roots of plants are eaten, and a great many seeds, especially those of pigweeds (*Chenopodium album* and *boscianum*) and wild sunflowers, which are abundant and form a considerable part of their diet. They also eat grasshoppers and many other insects. One that I shot as it ran out from under a shock of oats had 269 grains of oats in its cheek pouches. Mr. Ernest E. Thompson records 162 grains of oats taken from the cheek pouches of one and 240 grains of wheat and nearly 1,000 grains of wild buckwheat from those of another. Still the loss from ripe grain eaten, stored away, and destroyed in autumn is small compared with that which they cause by digging up the seed after it is sown in spring. Each kernel taken then deducts many fold from the autumn yield.

Dr. Coues has written the most complete account we have of the habits of Richardson's Spermophile, with which he became familiar when attached to the northern boundary survey along the forty-ninth parallel. He says:

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*That this surmise is correct is proved by the observations of Dr. A. K. Fisher, who found them active throughout the entire day, earlier in the season.

"It is one of the most abundant animals of our country, occurring by hundreds of thousands over as many square miles of territory, almost to the exclusion of other forms of mammalian life. Millions of acres of ground are honeycombed with its burrows. * * * I never saw any animals—not even buffalo—in such profusion. I have ridden for days and weeks where they were continuously as numerous as prairie dogs are in their populous villages. Their numbers to the square mile are vastly greater than I ever ascertained those of *S. beecheyi*, the pest of California, to be, under the most favorable conditions. In a word, their name is legion. If Dakota and Montana were the garden of the world (which they are not, however), either the gophers or the gardeners would have to quit. * * * Traveling among them, how often have I tried to determine in my mind what particular kind of ground, or what special sites they preferred, only to have any vague opinion I might form upset, perhaps in a few hour's more riding, by finding the animals as plentiful as ever in some other sort of a place. Passing over a sterile, cactus-ridden, alkali-laden waste, there would be so many that I would say 'this suits them best'; in camp that very night, in some low grassy spot near water, there they would be, plentiful as ever. One thing is certain, however; their gregarious instinct is rarely in abeyance. A few thousand will occupy a tract as thickly as the prairie dogs do, and then none but stragglers may be seen for a whole day's journey.

"Their choice of camping grounds is however wholly fortuitous, for all that we can discover, and moreover the larger colonies usually inoscu-late. * * * If the animals have any preference, it is a choice of the lighter and more easily worked soils, rather than a question of location. They seem to haunt especially the slight knolls of the prairie a few feet above the general level. There the soil is looser, and the inhabitants have some little additional advantage in their view of the surrounding country. But there are plenty of burrows in the heaviest soil of the creek bottoms. They dislike stony places for obvious reasons, yet they will often burrow beneath a single large rock. I have also found nearly horizontal holes of theirs dug from the face of an almost perpendicular bank. In short, there is endless diversity in the details of their habitations. * * * There is one very curious point in the socialism of these animals. Every now and then, in odd out-of-the-way places, where there may not be another gopher for miles perhaps, we come upon a solitary individual guarding a well-used burrow, all alone in his glory. The several such animals I have shot all proved to be males; and what is singular, these old fellows are always larger than the average (some would weigh twice as much), peculiarly sleek and light colored, and enormously fat. The earlier ones I got I suspected to be a different species, so peculiar were they in many respects. I suppose they are surly old bachelors who have forsworn society for a life of indolent ease, though if I had found them oftener among their

kind I should have taken them for the Turks of the harem. It seems to be a case somewhat parallel with that of the lonely old buffalo bulls so often met with away from the herd. The female brings forth in June. This I infer, at least, from the circumstance that July brings us plenty of young ones two-thirds grown. The young probably keep closely in the burrow until they are of about this size—I do not remember to have seen any smaller ones running about. * * * The gathering and hoarding of seeds seems to be their principal occupation during the summer.

"Amidst thousands that we pass only to see them skurry into their holes in trepidation, there are necessarily some observed which do not notice us or at any rate do not take alarm. I have often watched them, where the grass was taller than usual, gathering their store. They rise straight up on their haunches, seize the grass top and bite it off. Then, settling down with a peculiar jerk, they sit with arched back, and stow away their provender in their pouches with the aid of their fore paws. Their cheek pouches are not very large—both together would hardly hold a heaping teaspoonful. When duly freighted they make for their holes. Their mode of feeding, as they do, upon grass blades or any other herbage, as well as upon seeds, is essentially the same. In their foraging excursions, they seem to have regular lines of travel. From almost every long-used hole may be seen one or more little paths an inch or two wide, sometimes so well worn that they may be traced 15 or 20 feet. These paths often run from one hole to another. No matter how smooth the ground, these paths are never quite straight; they repeat in miniature the devious footpath across the meadow, the mysterious something that prevents an animal from walking perfectly straight being in force here. Though properly a vegetarian, like other rodents, the gopher is fond of meat, and I think that no small share of his summer's food is derived from the carcasses of buffalo. Wolves do not appear to be numerous, in summer at least, in this region, and the polishing of buffalo skeletons is largely accomplished by the kit foxes, badgers, skunks, and gophers. Hard by a slain buffalo a badger's hole is pretty sure to be soon established, together with a number of temporary gopher burrows. In proof positive of this carnivorous propensity, I have more than once seen the inside of a drying carcass completely covered with the peculiar and readily recognized excrement of the gophers, while the bones and flesh were gnawed in a way that plainly told who had been there. * * * Comical as a gopher is in some of his attitudes and motions, he never looks so funny as when squeaking. He generally gets down on all fours to it, drops his jaw with a jerk, and squeezes out the noise by drawing in his belly—it reminds one of a toy dog. If caught or wounded, they have an energetic chattering outcry, much like that of other species." * * * (American Naturalist, IX, 1875, pp. 148–154.)

In the interval of eighteen years since Dr. Coues published this

account of the spermophile's habits, changes have taken place. The Dakotas and Montana are not yet the garden of the world, though the Dakotas represent a fair share of the world's wheat field. Mile on mile of waving grain now occupies the ground then held in undisputed possession by the buffalo and spermophiles. The buffalo have disappeared and their bleached bones have been gathered up and sold. The spermophiles remain and are apparently increasing, much to the alarm and annual loss of the farmers of the region inhabited by them. The increase may be only apparent from crowding them out of plowed land to the bordering prairie. As the plow breaks up and fills their burrows and grain springs up high above their heads, they move to the edges of the fields, where more natural surroundings are found and where they can choose their food from either prairie or field. Thus covering a smaller area their numbers appear greater. At the same time their old enemies, badgers, weasels, foxes, and hawks, are destroyed or driven back from settlements, and the spermophiles multiply more freely unless a constant war of extermination be waged against them. As the situation becomes serious various means are employed for their destruction. County officers, in the hope of lessening their numbers, offer bounties with the only visible result of emptying the county treasury. Men and boys are employed on some of the farms to shoot and poison them. The Department of Agriculture is frequently appealed to for help or advice in the war against them.

*Injury to crops.*—Many complaints have been received, particularly from North Dakota, from farmers living in the region where Richardson's Spermophile is common. Mr. Rollin C. Cooper, of Cooperstown, Griggs County, writes as follows: "*Spermophilus richardsoni* is present in great numbers and very destructive to small grain, doing most damage after the grain begins to head out and shade the ground fully; they then pull down the grain and cut off the upper part of the stalk for many rods around their holes, seemingly to let sunlight strike the ground; they do not like damp places and are more numerous on rolling than on flat ground. I farm 7,000 acres and I think I can rid my farm of gophers at little expense by using wheat poisoned with strychnine."

Under date of July 15, 1889, Mr. G. W. Sewell, of Rugby, N. Dak., describes the manner in which this species injures the crops in Pierce county: "We have a gopher here that is so destructive that we shall have to do something to protect ourselves or leave the country. I have lived in the grasshopper and chinch-bug countries; the gopher is worse than either. We have a fine stretch of land south of the Turtle Mountains, but the entire community is discouraged by the destructiveness of the gophers which seem to be native to this part of Dakota. They go into the ground in September and October and stay till the snow melts, say April 20. Then they come in great numbers and seem to be always starved; they will eat anything: grass, grain, meat, potatoes,

onions, horse manure. When we commence working the land in spring they are all over the fields and eat the seed wheat. They come in from all the vacant land about and eat the wheat from the time it has sprouted until 2 inches high; then they eat the blades. By May 20 or the 1st of June they have a litter of about eight young. They destroy wheat, corn, beans, and dig out flax seed and potatoes. They commence cutting down stalks of wheat about June 15 and continue to cut them until ripe; then they shell out the grain and carry it into their holes. They cut down the prairie grass where there is no grain. At certain times they eat each other when found dead. They are too numerous to count. They have destroyed from 60 to 80 acres of grain for me, and in some places have destroyed 60 per cent of the crop."

Mr. Elmer T. Judd, writing from Cando, N. Dak., August 1, 1890, gives the following account of the damage done in Towner County and the means adopted for the destruction of this pest:

"The Richardson's Gopher which I send is one of almost countless numbers which are found in this county. They do a great deal of damage to the crops, commencing their work when the wheat and other grain are sowed, and continuing until after they are harvested. They dig up the seed and then eat the young shoots. During a dry spell they simply cut the stalks off for the moisture there is in them, and when the grain is nearly ripe they commence breaking down and picking the grain from the heads.

"Some farmers calculate they can make wages killing gophers in the extra amount of wheat they get at harvesting time. An old gentleman here, familiarly known as 'Grandpa Main,' who is in the neighborhood of 60 years of age, killed 1,500 gophers by actual count before the 1st of June, many of which he opened and found to contain from 5 to 7 young. From about the 1st of June until the middle of July this man and a cotton broker from St. Louis, Mo., who spends the summer here on his farm, calculated that they had killed over 2,500 more. One afternoon they killed 135, as shown by the tails they had captured. This shows the number of gophers one man could destroy if he paid strict attention to the business. The above 4,000 gophers were killed on and around the outer edges of one section of land—1 square mile."

Prof. C. B. Waldron, arboriculturist of the North Dakota Agricultural College and Experiment Station, reports that in eastern North Dakota this spermophile has extended its range considerably to the south and east during recent years, and has become much more abundant than formerly, while at the same time Franklin's Spermophile has decreased in the same area, the inference being that the latter is being driven out by Richardson's Spermophile, as the brown rat has driven away the black rat and the red fox the gray fox over large areas. Prof. Waldron says: "At Amenia, Cass County [N. Dak.], *Spermophilus richardsoni* first appeared in 1887 and has since

increased rapidly, *S. franklini* meanwhile diminishing till now perhaps not more than a dozen of the latter will be seen in the course of a whole season. At Leonard the *S. richardsoni* has appeared this season for the first time, but at Power, 10 miles south of there, it first appeared in 1891. At Jamestown this gopher was first noticed in 1884, though at Sanborn it seems to have appeared sooner, probably as early as 1876. At Mayville it first appeared in the seasons of 1886 and 1887, having entered that region from the west. Since there are areas of considerable extent in Barnes County where this species has never been noted, it would indicate that it has passed into its new habitat along irregular lines. Its movement in the second tier of counties west of the Red River seems to have been south and east.

"*Spermophilus richardsoni*, which bears the characteristic and very appropriate name of 'flickertail,' is harder to contend with than any other species of this genus, the damage done by it being more and more each year. Its chief depredations are committed during the months of June and July when growing grain, especially corn, peas, and garden crops are apt to be entirely destroyed by it. It is found in greatest abundance in the agricultural regions lying just west of the Red River Valley and seems to thrive best in the presence of civilization. For several years it has been encroaching upon the farms in the Red River Valley proper, but the wet season of last year [1891] very nearly or quite exterminated it on the level lands."

## FOOD.

The following table prepared from the examination of the stomachs of eighteen specimens will give a more definite idea of the character of the food of this species. Unfortunately the dates at which these specimens were taken cover little more than half of one month, none being taken in spring or early summer, when their diet is of greater importance in relation to agriculture.

*Summary.*—Animal matter, 9.5 per cent; vegetable matter, 90.3 per cent; indeterminate matter, .2 per cent.

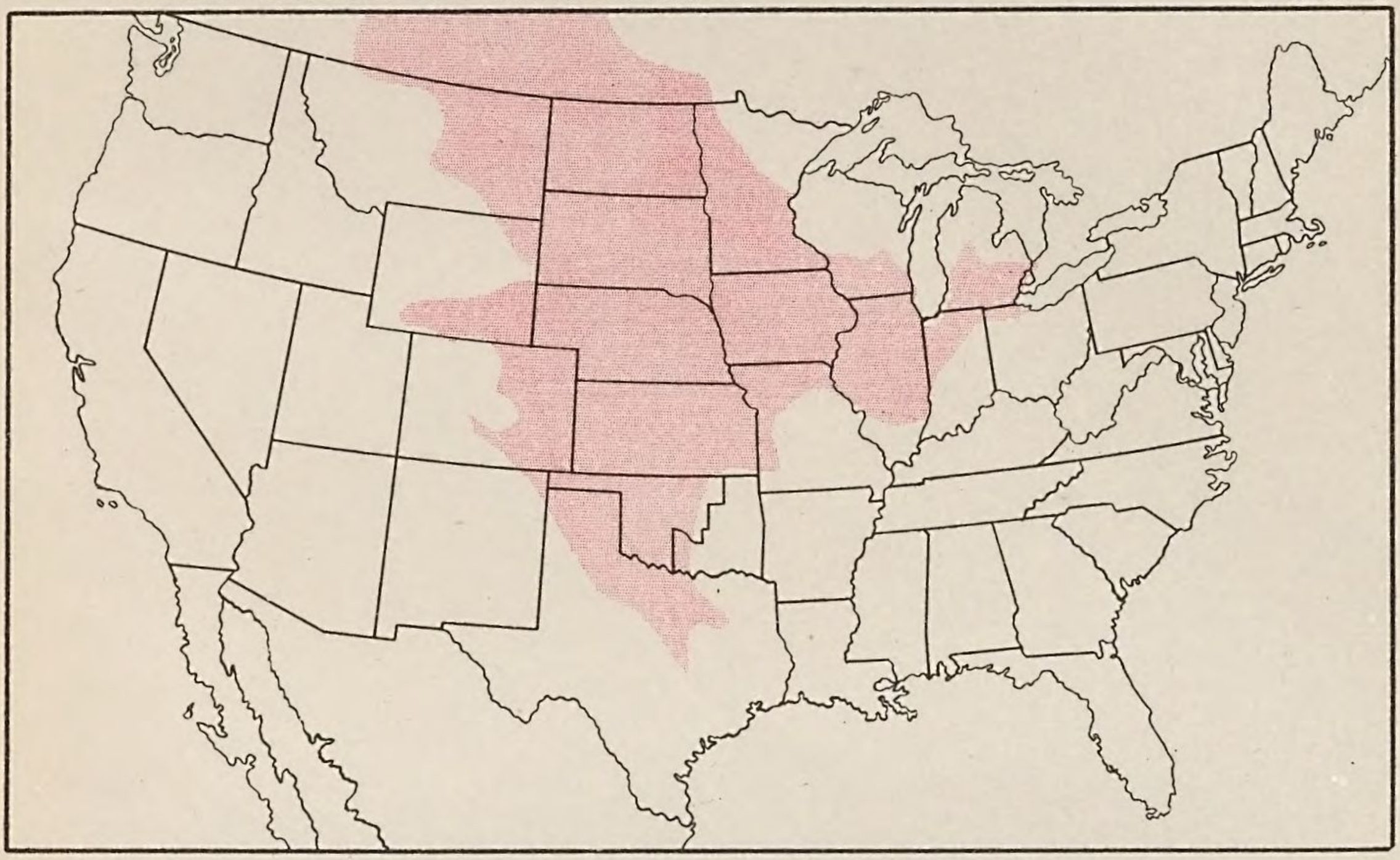
This shows a diet of less insect and more vegetable matter than that of either the Gray or Striped Spermophile, but the stomachs of this species were all collected during the month of August, when in the latitude of 48° to 49°, insect life is waning and there is a profusion of the rich, oily, and fat-producing seeds and grains. However, the large proportion of green herbage found in their stomachs clearly proves them to be far more herbivorous than is usual with others of the genus and shows a close connection in food habits, as well as in many other respects, with the prairie dog.

*Table showing contents of 18 stomachs of Richardson's Spermophile (Spermophilus richardsoni).*

| Cat. No. | Sex. | Date. | Locality. | Percentage of animal matter. | Percentage of vegetable matter. | Contents. |
|---|---|---|---|---|---|---|
| | | 1887. | | | | |
| 220 | ♂ | Aug. 13 | Devils Lake, N. Dak .. | ..... | 100 | Mostly oats; some herbage. |
| 222 | ♂ | Aug. 15 | .....do ..... | 20 | 80 | A few small insects; mouse hair; mostly herbage or roots. |
| 223 | ♂ | Aug. 15 | .....do ..... | 5 | 95 | A few bits of insects; grain; herbage; a *Polygonum* seed. |
| 225 | ♂ | Aug. 17 | .....do ..... | ..... | 100 | Herbage; *Chenopodium* seeds; *Solanum* seeds and berries. |
| 226 | ♂ | Aug. 17 | .....do ..... | ..... | 100 | Half wheat; nearly half green herbage; a few small seeds. |
| 227 | ♂ | Aug. 17 | .....do ..... | ..... | 100 | Oats. |
| 233 | ♂ | Aug. 24 | Bottineau, N. Dak .... | ..... | 98 | Mostly barley and seeds of bindweed; few particles of indeterminate material. |
| 234 | ♂ | Aug. 24 | .....do ..... | 10 | 90 | Grasshoppers; grain; green foliage. |
| 235 | ♂ | Aug. 24 | .....do ..... | 10 | 90 | Hair; mostly green herbage; probably grass. |
| 236 | ♂ | Aug. 24 | .....do ..... | 75 | 25 | Finely chewed insects (probably mostly grasshoppers); plants; *Chenopodium* seeds. |
| 237 | ♂ | Aug. 24 | .....do ..... | 5 | 95 | Insect remains; shell of black beetle; *Solanum* seeds; small seeds; plants. |
| 238 | ♂ | Aug. 24 | .....do ..... | 5 | 95 | A few insects; a little grain; mostly chewed roots. |
| 239 | ♂ | Aug. 24 | .....do ..... | 5 | 95 | Grasshoppers; barley; *Polygonum* seeds; green herbage. |
| 240 | ♂ | Aug. 24 | .....do ..... | 20 | 80 | Grasshoppers; grain and herbage in about equal amounts. |
| 241 | ♂ | Aug. 24 | .....do ..... | 1 | 99 | One small feather; chewed leaves and seeds; *Chenopodium* seeds. |
| 251 | ♂ | Aug. 26 | .....do ..... | ..... | 99 | Mostly barley; a few *Polygonum* seeds; some indeterminate matter. |
| 257 | ♂ | Aug. 29 | .....do ..... | ..... | 100 | Green herbage; seeds of *Helianthus* and *Chenopodium*. |
| 258 | ♂ | Aug. 29 | .....do ..... | 15 | 85 | Grasshoppers; green herbage; *Helianthus* and *Chenopodium* seeds. |

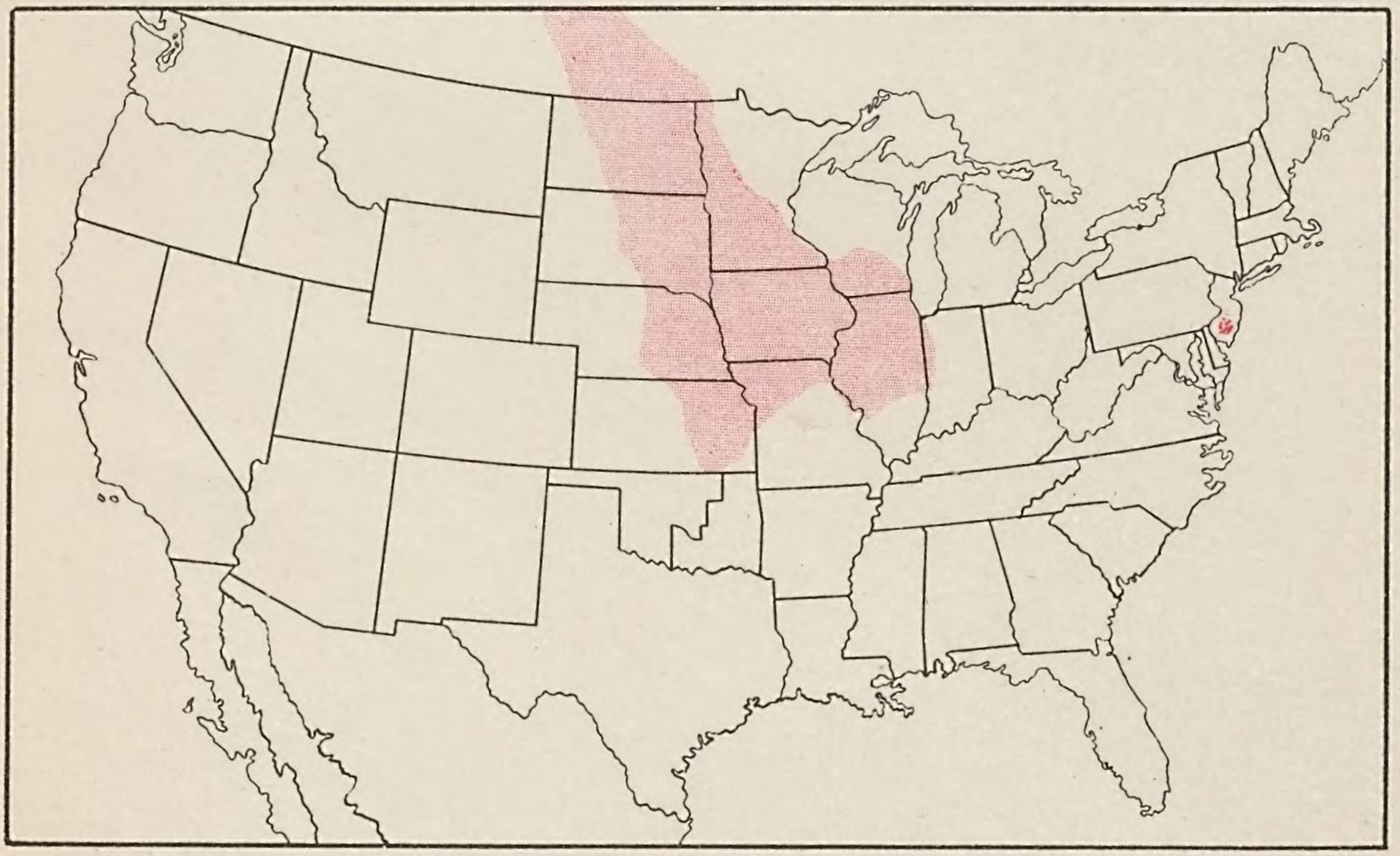
# INDEX.


Aldrich, J. M., on examination of stomachs of striped spermophile, 11, 40–42.
Bounties in Iowa, 20.
Kansas, 20.
Minnesota, 20–21.
Montana, 21–22.
North Dakota, 18–19.
South Dakota, 19.
Washington, 22.
Bisulphide of carbon, experiments with, 27–30.
success of in destroying spermophiles, 29–30.
Circular on distribution, 12.
Colorado, injury to crops by striped spermophile, 38.
Franklin's spermophile, 48–57.
appearance in spring, 51–52.
description, 48–49.
food, 55–57.
habits, 51.
injury to crops, 52–55.
introduction into New Jersey, 50–51.
range, 49–50.
table showing contents of 29 stomachs, 57.
Gillette, C. P., on examination of stomachs of striped spermophile, 40.
food-habits of striped spermophile, 10–11.
Hawks and owls that feed on spermophiles, 16–17.
Hilgard, E. W., on destruction of ground squirrels with bisulphide of carbon, 10, 29–30.
Illinois, injury to crops by gray and striped spermophiles, 54–55.
Iowa, bounties in, 20.
injury to crops by striped spermophile, 36–37.
Kansas, bounties in, 20.
injury to crops by striped and gray spermophiles, 38. 52–53.
Kennicott's spermophile, 58–59.
description, 58.
food, 59.
habits, 58–59.
range, 58.
Mexican spermophile, 46–48.
description, 46.
habits, 47–48.
range, 47–48.
Minnesota, bounties in, 20–21.
injury to crops by striped and gray spermophiles, 36.
Montana, bounties in, 21–22.
Nebraska, injury to crops by striped, gray, and Kennicott's spermophiles, 37–38, 52.
North Dakota, bounties in, 18–19.
injury to crops by gray and Richardson's spermophiles, 53, 64–66.
Poison, bisulphide of carbon, 26–30.
strychnine, 25–26.
free distribution of, 23
Richardson's spermophile, 59–67.
description, 59–60.
food, 63.
habits, 60–64,
injury to crops, 64–66.
range, 60.
tables showing contents of 18 stomachs, 67.
South Dakota, bounties in, 19
Spermophiles, enemies of, 15–18.
badger, 17.
hawks, 16.
owls, 16.
weasel, 18.
found in stomachs of hawks and owls, 17.
species in United States, 9.
Mississippi Valley, 10, 30.
Spermophilus tridecemlineatus, 31–46.
franklini, 48–57.
mexicanus, 46.
range of genus, 9.
richardsoni, 59–67.
elegans, 59.
spilosoma obsoletus, 58–59.
Striped prairie spermophile, 31–46.
appearance in spring, 34–35.
description, 31.
habits, 32–34.
hibernation, 35–36.
injury to crops, 36–38
range, 31–32.
table showing contents of 80 stomachs 43–45.
table showing contents of cheek pouches, 46.
Washington, bounties in, 22.
injury to crops by Townsend's spermophiles, 24.
Wyoming Spermophile, 30.
Wyoming, injury to crops by spermophiles, 60.

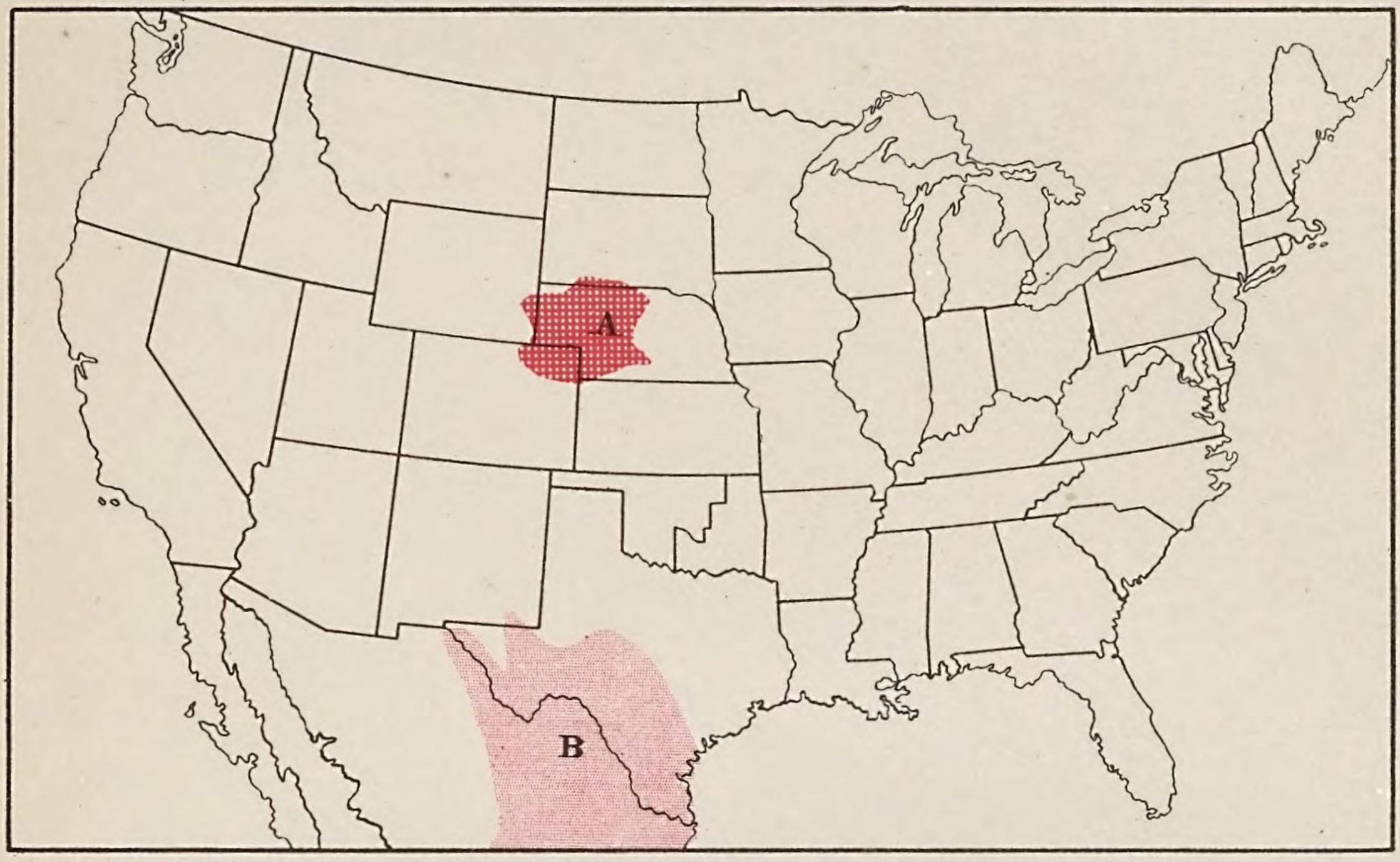


DISTRIBUTION OF THE STRIPED SPERMOPHILE
(*Spermophilus tridecemlineatus*)

MAP 2

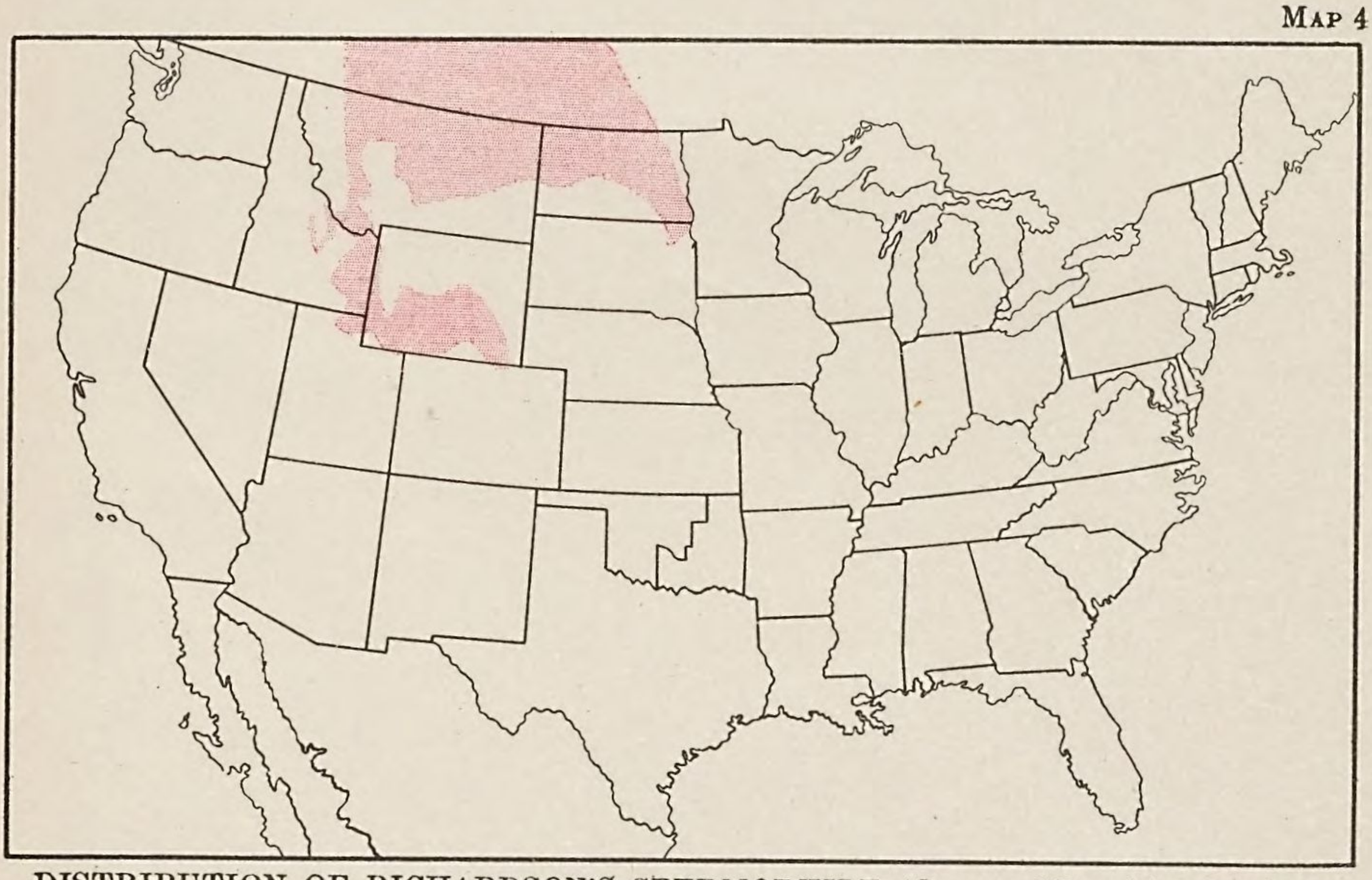


DISTRIBUTION OF FRANKLIN'S SPERMOPHILE
(*Spermophilus franklini*)




A. DISTRIBUTION OF KENNICOTT'S SPERMOPHILE (*Spermophilus s. obsoletus*)
B. DISTRIBUTION OF THE MEXICAN SPERMOPHILE (*Spermophilus mexicanus*)

MAP 4



DISTRIBUTION OF RICHARDSON'S SPERMOPHILE (*Spermophilus richardsoni*) and THE WYOMING SPERMOPHILE (*Spermophilus richardsoni elegans*)

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